United Nations
Economic Commission for Africa

THE EAST AFRICAN MONETARY UNION:

Ready or Not?

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EXECUTIVE SUMMARY

This paper investigates the readiness of the East African Community (EAC) for a monetary union by assessing if countries meet the optimum currency criteria (OCA). EAC Partner States are in the process of implementing the Protocol on the Establishment of the East African Community Monetary Union (EAMU), which was signed in November 2013 and will lead to the use of a common currency by 2024. The general conclusion of this paper is that, despite some structural similarities, EAC economies remain susceptible to asymmetric (country-specific) shocks. In particular, the empirical analysis points to (only) partial convergence among inflation and exchange rates, suggesting that EAC countries need to better align their monetary policies and allow a period of monetary policy coordination.

Therefore, it is advisable to undertake measures to fast track the full implementation of the common market and customs union protocols, further harmonize policies, and increase intra-regional trade before adopting a common currency. Adopting a common currency before attaining a greater level of convergence may be damaging to EAC countries.

While drawing from the experiences of other currency unions, it will be important that the EAC continues to direct efforts to designing and putting in place adequate mechanisms that can help member countries adjust to future shocks once the common currency is adopted. This includes the usual measures to mitigate the costs of common monetary policies, such as labor and capital mobility, price and wage flexibility, as well as various risk-sharing mechanisms – including fiscal policy. This will require that EAC countries agree to explicit and binding convergence commitments as prerequisites and ongoing commitments for the viability of EAMU. To achieve this, there is a need for the establishment of an institution (or a strong mechanism) for enforcing and ensuring compliance by all countries. Firm commitment, discipline among members, and reduction of the risk of bad policies are results of a more rule-based framework. These measures should be agreed among member countries before the introduction of the single currency, to reduce risks and signal early commitment to macroeconomic stability.

To ensure good preparation on the establishment of EAMU, Partner States shall agree to fast track the establishment of the East African Monetary Institute (EAMI), initially planned to start operating in 2015. EAMI is responsible for the preparatory work for the monetary union.

1. BACKGROUND

The rationale for the creation of monetary unions in Africa is driven by different factors, including: the possibility of creating more solidarity among African countries (Cobham and Robson, 1994, p. 286; Masson and Pattillo, 2004, p. 10); the experience of the European monetary union, which is perceived to have been successful in bringing benefits to its members (Masson and Pattillo, 2005, p. 34; Jefferis, 2007, p. 83); monetary union viewed as a way of achieving an efficient single market (Kenen and Meade, 2008, p. 4); and as a way to improve structures of the economies, to increase trade-integration and business-cycle correlation, and enhancing the credibility of macroeconomic policies (Frankel and Rose, 1998; Rose, 2000).

Studies on the readiness of countries to form monetary unions have been guided by the theory of optimum currency areas (OCA), which was developed by Mundell (1961), McKinnon (1963) and Kenen (1969), and became popular for analysis of the costs and benefits of monetary integration. The benefits are directly related to the elimination of transaction costs due to exchanging currencies and exchange rate volatilities. Costs are related to the inability of the central bank in individual countries to use country specific monetary and exchange rate policy as an instrument of macroeconomic adjustment. Thus, the benefits and costs arising from the establishment of a monetary union depend on the structural characteristics of the economies concerned. The basic point of the OCA theory is that countries or regions exposed to symmetric shocks, or possessing mechanisms for the absorption of asymmetric shocks, may find it optimal to adopt a common currency.

Thus, OCA theory focuses on asymmetric disturbances to output, trade linkages and the mobility of labor, and considers that countries with intense trade relations are likely to gain relatively more from monetary integration. This explains why meeting the optimum currency criteria before forming a monetary union is important. However, Frankel and Rose (1998) suggest that a common currency can promote trade and economic growth, and that countries could become more similar after joining a monetary union. This suggests that it may not be crucial for members to meet OCA criteria before forming a currency union. However, recent studies have shown a much smaller trade impact, particularly in developing countries. This reinforces the importance of meeting optimum currency criteria as prerequisite for the EAMU.

The EAC member states signed the Protocol on the Establishment of the East African Community Monetary Union (EAMU) in November 2013 as the third stage of integration in the region, aiming at launching a single currency by 2024. Indeed, the treaty for the establishment of the East African Community (EAC) signed by the Heads of State of Kenya, Tanzania, and Uganda in November 1999, which entered into force in July 2000, defines four different stages of integration. These include a Customs Union, a Common Market, a Monetary Union, and a Political Federation. Burundi and Rwanda acceded to the EAC Treaty in June 2007, while South Sudan gained accession in April 2016. The key objective of the EAC is to broaden and deepen cooperation among Partner States in a wide range of areas, including economic, social, political, security, and judicial affairs.

The first stage entailed a Customs Union and came into effect in 2005. This enables Partner States to operate as a free trade area by reducing or eliminating taxes on goods traded within the community, while having a common tariff on goods imported from other countries. ounding members of EAC (Uganda, Kenya and Tanzania) set common external tariffs (CET) in 2005, which were adopted by Rwanda and Burundi after joining the community. The purpose of CET was to protect industries of significance to

those countries by allowing firms to take advantage of economies of scale in production, selling to a wider market and encourage foreign direct investment (FDI) in the region by allowing international firms free access to a larger market than that of the individual member countries.

Different tariff rates were set: 0% for raw material; 10% for intermediate inputs or semi-finished goods, and 25% for finished goods. However, this classification (0-10-25) poses some challenges in its implementation. A number of goods that are subject to the 25% tariff line are classified as raw materials or intermediate inputs according to the UN Board Economic Categories (BEC) classification (TMEA, 2015), which is likely to harm some countries. In addition, sensitive items (SI) under CET that have tariff rates in excess of 25% have been constraining. Individual countries have repeatedly applied for exemptions[1] to apply different rates for a period of one year.

The EAC Common Market, which entered into force on July 2010, is the second stage of integration. It provides free movement of goods, services, labour, and capital.

East African Monetary Union (EAMU)

The stated objective of the EAMU is to "promote and maintain monetary and financial stability aimed at facilitating economic integration to attain sustainable growth and development of the community." As pre-requisites for the EAMU, EAC countries ought to: (i) harmonize and coordinate fiscal, monetary and exchange rate policies; (ii) adopt common principles and rules for payments and settlements; (iii); harmonize policies and standards on statistical information; (iv) introduce bands and gradually fix their bilateral exchange rates; and (v) integrate their financial systems and adopt common principles and rules for the regulation and supervision of the financial system. Moreover, Partner States ought to phase out any outstanding national central bank lending to the government and public entities, while attaining and maintaining the pre-defined macroeconomic convergence criteria for at least three consecutive years before 2024.

Inherent to a monetary union is the conduct of a single monetary and exchange rate policy in the interest of the single currency area as a whole. A system of central banks will be adopted with a single regional central bank (the East African Central Bank, EACB) to replace the existing National Central Banks (NCBs), which could become its local arms. The primary objective of monetary policy shall be to achieve and maintain price stability. Without prejudice to the primary objective, monetary policy shall contribute to financial stability and economic growth. In addition, to enable the EACB to conduct its exchange rate policy and to give the EACB control over the use of foreign currency, a system of pooled reserves will be adopted. In that framework, which consists of centralizing the holding and management of foreign reserves, the NCBs will be transferred foreign reserve assets in addition to subscribing to and paying up the capital of the EACB.

The monetary affairs committee (MAC) of EAC Central Bank Governors was created to harmonize monetary and exchange rate policy formulation and implementation as well as the regulatory frameworks of financial sectors in the region to ensure their stability and development. In their effort of coordinating and harmonizing monetary and exchange rate policies during the transition to the monetary union, EAC central bank governors decided to adopt a price-based monetary policy framework by 2018 as money demand functions have become unstable and thus limiting the effectiveness of monetary policies in the region. To achieve that objective, clear measures were adopted to develop the interbank markets in all

countries and harmonize monetary policy instruments. For example, an agreement to harmonize reserve requirement regimes in EAC countries by setting the reserve requirement ratio at 5% and the maintenance period to two weeks was reached.

Currently, the reserve requirement ratio is 5.25% in Kenya, 8% in Tanzania, 10% in Uganda, 5% in Rwanda and 3% in Burundi. Central banks also agreed to design and implement a Common exchange rate mechanism, continually assess exchange rate misalignments in the region, develop capacity in modeling and forecasting, and adopt the Forecasting and Policy Analysis System (FPAS) as well as a common monetary policy communication strategy. Governors have been meeting twice a year to assess the progress achieved and take additional measures to accelerate the implementation of their decisions.

Important achievements are also recorded in payment system development and harmonization. They include, the integration of payment systems in the EAC region; harmonization of payment system standards for clearing and settlement systems; promotion of interconnectivity of payment cards switches; harmonization of payment systems legal, regulatory and institutional frameworks as well as cross border mobile money initiatives. On the financial system stability and development side, focus was put on integration of financial systems and adoption of common principles and rules for the regulation and supervision of the financial system; development and harmonization of criteria of the Basel Core Principles (BCPs); review, consolidation and harmonization of the existing financial stability assessment frameworks and establishment of working group on macro prudential analysis and stress testing (MAST).

However, the absence of any agreed rules and enforcement mechanism poses challenges to the implementation of decisions by the monetary affairs committee of EAC central bank governors as well as decisions by other EAC committees. Indeed, policy coordination and harmonization becomes problematic in the absence of a rule-based framework that creates discipline among members and reduces the risk of bad policies (Currie, Holtham, and Hughes, 1989). The recent euro zone debt crisis is a good example of weakly enforced rules and inadequate policy coordination. In the case of EAC, the implementation of some decisions of EAC central bank governors has been delayed or decisions changed because they are not binding. For example, the decision of governors to set the reserve requirement ratio at 5% by 2018 was modified in 2017 because one central bank failed to manage liquidity in the banking sector and decided to maintain its reserve requirement ratio at a high level for a period of four years. Some countries have also postponed the adoption of price-based monetary policy to 2021, instead of 2018 as initially agreed by EAC central bank governors. The lack of firm commitment to implement decisions taken by different regional committees to fast-track the implementation of EAMU protocol – due to more focus on relative national gains and sovereignty – is one of big challenges in the journey towards full regional integration.

There are a few studies assessing the readiness of EAC countries to adopt a monetary union. Two main conclusions emerge from those studies. First, exchange rates in EAC countries mostly absorb real asymmetric shocks with the exception of Burundi, exchange rate shocks being a source of disturbances to inflation and not to GDP (Paulo Drummond, at al. 2015). Second, there is not clear evidence about synchronization of business cycles and macroeconomic convergence, suggesting that there could be substantial costs for the member countries from a fast-tracked process (Buigut, 2011; Rusuhuzwa & Masson, 2012; Davoodi et al., 2013; Mafusire & Brixiova, 2013; Lepetit et al., 2014; Asongu, 2014bc; Buigui & Valev, 2005; Falagiarda, 2010; Kishor & Ssozi, 2011; Sheik et al., 2011). The overall objective of this research is to reassess the readiness of East African Community countries for a monetary union, mainly by covering the recent period – when progress was made in policy coordination and implementation of

the common market protocol. In addition, this paper is a contribution to the existing literature on the assessment of the feasibility of different monetary blocks in Africa, using the case study of EAC.

The rest of the paper is structured as follows. In the section 2, we present a summary of literature review. In the section 3 we analyze how EAC countries have been achieving convergence criteria. In section 4, we evaluate additional indicators linked to OCA theory. In section 5, we conduct an empirical analysis on the readiness of EAC countries to form a monetary union, and in the last section, we provide policy recommendations.

2. LITERATURE REVIEW

2.1 Theoretical literature review

Most empirical studies on monetary unions have focused on the capacity of the countries concerned to satisfy the optimum currency area (OCA) criteria considering that economies subjected to similar terms-of-trade shocks are more suitable candidates for a monetary union. The reason is that exchange-rate adjustment between those economies will not be needed and this will permit the implementation of a common monetary policy (e.g. Mundell, McKinnon, 1963). The elimination of the transaction costs due to exchanging currencies and exchange-rate volatility are the two main benefits of monetary unions (Robson, 1987, p. 140; Tavlas, 1993). On the other hand, the main costs of monetary unions are those attributable to the inability of monetary authorities of the individual countries to use country-specific monetary policies and the exchange rate as an instrument of macroeconomic adjustment in response to shocks.

This explains why the analysis of the gains and losses arising from the establishment of monetary unions focuses on the structural characteristics of the candidates for a monetary union such as (1) analysis of the nature of shocks affecting the economies considered; (2) assessment of the correlations of movements of real exchange rates and/or the terms-of-trade among the economies; and, (3) analysis of co-movements in cyclical real growth rates among the economies.

While earlier work on OCA focused on identifying the characteristics that an economy should satisfy prior to joining a monetary union (i.e., ex ante), the endogenous theory of OCA has focused on changes in economic structure and performance that may result from participation in a monetary union. In other words, the adoption of a common currency can improve the structural characteristics of the economies concerned, increasing trade-integration and business-cycle correlation, and enhancing the credibility of macroeconomic policies (Frankel and Rose, 1998; Rose, 2000). This implies that the participation in a currency area becomes more favorable after a country joins a currency union than before. Thus, the creation of a monetary union can itself create conditions that are favorable for the well-functioning of the union (De Grauwe, 2007, p. 27).

Endogenous OCA theory posits that a common currency can promote trade and growth. In addition to removing the costs of currency conversion, a single currency and a common monetary policy increases price transparency, facilitate (foreign direct and portfolio) investment, and the building of long-term relationships. These outcomes would promote reciprocal trade as a result, economic and financial integration, and the accumulation of knowledge. Countries could then become more similar in a currency union than before joining the union (Rose at.al, 2001; Mongelli, 2002).

2.2 Empirical literature review

Empirical research on the feasibility of monetary unions differ in terms of empirical methodologies, countries considered and sample periods, which makes results difficult to compare. Various methodologies have been applied, including: (i) analysis of correlations of real growth rates, exchange rates and terms-of-trade; (ii) correlations of shocks identified using a statistical transformation of the data or a Structural Vector Autoregression (SVAR) model; and (iii) a cointegration VAR approach. Studies that report correlations of real per capita growth rates aim to provide information on underlying shocks, the idea being that, apart from the impact of trend, movements in output are driven mainly by shocks, considering that cyclical movements in output are the primary result of the shocks.

Bayoumi and Ostry (1997) in their study of 11 SADC countries calculated bilateral output correlations among country pairs and found that bilateral correlations among SADC countries tend to be positive but small and insignificant. In contrast, Karras (2007) calculated correlations for 9 SADC countries against the SADC as a whole, and suggest a monetary union of Malawi, Mozambique, South Africa, Zambia, and Zimbabwe. He calculated correlations of de-trended output growth of nine SADC countries using real GDP based on purchasing-power-parity real exchange rates, using the following three methods to estimate the cyclical component of output: (1) first differencing, (2) the Hodrick-Prescott (HP) filter, and (3) the Band-pass (BP) filter to remove the trend from output growth.

Similarly, Buigut and Valev (2006), using the Blanchard-Quah decomposition technique suggest a monetary union of the CMA countries including Mozambique and Zambia. Using the same technique and cluster analysis to group several variables, Buigut (2006) also obtained support for a monetary union, considering the rand as the anchor currency. His optimum cluster analysis supported monetary union comprising Botswana, Namibia, Seychelles, South Africa, and Swaziland. Results obtained by Masson and Pattillo (2005) and Wang et al. (2006) are less supportive of monetary union among SADC countries. Masson and Pattillo (2005) estimated correlations of percent changes in the terms of trade for 14 SADC countries; Wang et al. (2006) calculated correlations of per cent changes in the terms of trade for Botswana and the four CMA economies.

Jefferis (2007) calculated correlations of movements of bilateral nominal exchange rates of twelve SADC countries against the South African rand. It concludes that there is convergence comprising the CMA countries (South Africa, Lesotho, Namibia and Swaziland) and Botswana, Mauritius, Mozambique and Tanzania. However, those countries remain far from satisfying the other prerequisites for monetary union, including significant intra-regional trade, and full capital and labour mobility.

A limitation of this approach is that the techniques do not make a distinction between disturbances to output growth and the policy responses to the disturbances. In addition, the approach does not account for the situation where an identical shock may affect individual countries differently due to differences in key factors such as wage and price flexibility, tax structure, and trade responsiveness (Mélitz, 1991, p. 321; Tobin, 1993).

In order to deal with these limitations, some authors use econometric methods to extract the underlying disturbances from real output. Yehoue (2005), and Wang et al. (2007) employed a three-step autoregressive estimation procedure. The growth of per capita GDP (measured as the change in the logarithm of real GDP per capita) was regressed upon its own first and second lags. The residuals from this regression (or a

measure of the residuals, such as the standard deviation of the residuals) were considered as underlying real output disturbances, and correlations among disturbances were calculated.

Based on the historical data on inflation, trade, and the co-movements of prices and output, Yehoue argue that the emergence of large-scale currency blocs in Africa will follow a gradual path and that this dynamic does not lead to the emergence of a single continental currency at this time. Rather, the study suggests three blocs: one in West Africa, a second around South Africa, and a third in Central Africa.

The study by Wang (2007) shows that the current CMA arrangements, although not a full monetary union, have delivered many benefits of a full monetary union in line with its two goals (promoting sustained growth in the CMA as a whole and facilitating economic development in less developed member countries). Real GDP growth in the CMA as a whole has accelerated over the last two decades, and real income per capita has converged. However, this convergence of per capita income has slowed down in recent years, showing that countries are facing different challenges.

While the autoregressive approach helps separate the underlying shocks from the data, it does not separate demand and supply shocks. To address this problem, different studies have used the Vector Auto regression (VAR) technique. Bayoumi and Eichengreen (1992) were among the first to identify the underlying structural shocks using the Vector Auto regression (VAR) technique developed by Blanchard and Quah (1989) and measured the incidence of asymmetric demand and supply shocks across members of the former European Community (EC) and compared them with the ones prevailing in the United States. The idea is that asymmetric supply shocks are likely to continue after monetary unification, while asymmetric demand shocks are likely to diminish (since they are partly policy induced). Thus, countries that are confronted with relatively large asymmetric supply shocks are not likely to be good candidates for monetary union.

Since then, a large literature (including on optimum currency area) has applied this methodology or a related approach to different country groups in Europe (Bayoumi and Taylor 1995, Ramaswamy and Slok, 1998, Kouparitsas ,1999; Fidrmuc and Korhonen, 2001 and Frenkel and Nickel, 2002) and in East Asia (e.g. Yuen and Ling, 2001 and Zhang et al, 2004).

It is important to mention that the Blanchard-Quah technique has its limitations, such as restraining any relationship among variables to be linear and considering that there are only two kinds of shocks in the economy: a supply shock that is assumed to be permanent and a demand shock that is assumed to be temporary.

Grandes (2003) and Khamfula and Huizinga (2004) used a cointegration approach for Botswana and the four Common Monetary Area (CMA) countries and tested for cointegration among bilateral real exchange rates, using the rand as the base currency. If the relationships were stationary, the author inferred that the real exchange rates exhibited common trends and that the countries had been subjected to symmetric shocks. He concludes that the CMA and Botswana form an optimal currency area using a Generalized Purchasing Power Parity model.

Multivariate cointegration analysis has been applied by a number of authors to test convergence, especially for the European Monetary Union (EMU). Haug et al. (2000) used cointegration techniques to analyze which of the European Union (EU) countries would form a successful monetary union based on

the nominal convergence criteria defined in the Maastricht treaty. Brada and Kutan (2002) compared the convergence of monetary policy of the Balkan and Mediterranean candidates for EU membership with Germany as a proxy for the European Central Bank (ECB).

Khamfula and Huizinga (2004) used a GARCH model to estimate correlations of unanticipated components of bilateral real exchange rates of nine SADC countries against the South African rand, using both monthly and quarterly data over the period 1980-96. The methodology is based on the following three steps:

- Calculate bilateral real rates against the rand and seasonally adjust the change in each bilateral rate using seasonal dummies. Calculate two sets of residuals: one for the monthly data and the other for the quarterly data, used as estimates of unanticipated residuals;
- Regress each of the residuals on its own lags (up to seven lags);
- Squares of unanticipated residuals are used as measures of underlying shocks.

In this approach, monthly and quarterly residuals characterize short-run and long-run shocks respectively. Their results indicate low degrees of symmetry of the real exchange rate shocks across most of the countries, suggesting that a monetary union would entail high costs relative to benefits.

There are a number of empirical studies on the feasibility of a monetary union in the EAC. Mkenda (2001) employs a Generalized Purchasing Power Parity (GPPP) model developed by Enders and Hurn (1994). This approach uses cointegration methods to find if the prospective countries' macroeconomic variables exhibit long-run relationships. Economies suitable for a monetary union experience symmetric shocks to their macroeconomic variables and thus on average 'move' together. GPPP postulates then that the real exchange rates between countries comprising an optimal currency area should be cointegrated. However, this approach does not distinguish disturbances from responses, because movements in macroeconomic variables reflect the combined effects of shocks and responses (Angeloni and Dedola, 1999).

Buigut and Valev (2006) used a VAR model, adopting the identification scheme of Blanchard and Quah (1989). The study by Rusuhuzwa and Mason (2012) used different methodologies and data covering the period 1995-2010. First, the paper examined if EAC countries face correlated trend and cyclical components of their macroeconomic indicators (such as GDP) using a Hodrick-Prescott (HP) filter. The paper used a VAR model to identify supply shocks, and furthermore, a cointegration approach to test if real effective exchange rates were cointegrated.

Buigut (2011) applied multivariate cointegration to the case of EAC countries using quarterly data covering the period 1997Q4-2009Q1, considering several criteria (nominal exchange rates, real exchange rates, and inflation rates, monetary base and real output). The monetary base is included as an indicator of monetary policy convergence in absence of consistent long-term interest rate data. The monetary aggregate is preferred over other broader aggregates because it is less diluted by intervention by other agents in the financial system, and better able to capture the central bank's policy stance.

Drummond et al. (2015) use different methodologies to identify the degree of susceptibility of EAC economies to suffer asymmetric shocks; assesses the value of the exchange rate as a shock absorber for these countries; and reviews adjustment mechanisms that would help ensure a successful experience under the monetary union. The study concluded that despite some similarities in the structures of their economies, country-specific shocks have been prevalent in the last two decades, with EAC economies remaining susceptible to asymmetric shocks. While the declining dispersion of growth rates across

countries suggests gradual move toward economic convergence in the last decade, cluster analysis indicates that dissimilarities remain large.

The literature surveyed in this section contains mixed evidence of monetary union blocs in Africa. Despite the symmetry and co-movement of various macroeconomic variables in some countries, country-specific shocks have been identified suggesting that fast tracking the formation of proposed monetary blocs in Africa may not be appropriate. Countries need a sufficient period to implement policies to comply with the optimum currency criteria.

3. CONVERGENCE CRITERIA

Convergence criteria are rooted in the OCA theory, which stipulates that economies with similar structures have greater benefits in being members of currency unions. Convergence is seen as necessary to form a monetary union, and various monetary blocs have adopted convergence criteria similar to those in the European Monetary Union (EMU), although setting different targets on macroeconomic variables. Based on the EMU experience, convergence criteria are obligatory for all countries seeking to join a monetary union.

As mentioned, the experience of the EMU has been perceived as successful in bringing benefits to its members. This explains why planned monetary unions have adopted convergence criteria similar to those in Europe and formally intend to converge like in Europe. However, in the case of Africa, the ability of small poor countries to meet strict criteria may be limited and one can expect to see planned monetary unions in Africa taking a bit longer to be established.

However, there might be strong political pressures to create currency unions in Africa even before the convergence criteria are met – due to high expectations about the benefits of monetary unions, such as lower financial transactions costs, more stable monetary conditions, greater exchange rate stability, better price signals, financial market integration, and the objective of creating more solidarity among African countries. This is a challenge, because monetary unions require strong convergence, resulting from efficient policies, institutions and regional infrastructures to avoid considerable costs attributable to the inability of monetary authorities of the individual countries to use country specific monetary and exchange rate policy as an instrument of macroeconomic adjustment in response to shocks.

It is therefore critical to examine how economies are converging before forming a monetary union, or at least examine whether there is clear evidence of structural similarities among monetary union members, free movement of labor, a high degree of economic openness, an enabling business environment and economic diversification.

One key issue in proposed unions relates to asymmetries in the size and strength of individual members, the nature of shocks affecting those economies, as well as the nature of policies used to deal with those shocks. In case countries agree to establish a monetary union with limited convergence, the success may depend on the extent to which the largest members may be willing to support smaller members until greater convergence can be achieved.

About the nature of shocks, the literature distinguishes two shocks hitting the countries on path to become members of a monetary union, namely symmetric and asymmetric shocks. Symmetric shocks affect all

union member countries in similar ways. An example could be a sharp hike in food prices that affects all EAC countries. In the presence of symmetric shocks, a single monetary policy for the entire union is more likely to be successful. On the other side, asymmetric shocks hit union member countries distinctively. An example would be a hike in international oil prices that may affect economies differently: those that produce oil versus those that are net oil importers. In that case, countries within a monetary union cannot rely on traditional monetary policy and exchange rate, and therefore must rely on other policies available to them (such as taxation, public expenditure, market development, etc.) to deal with the shocks.

EAMU CONVERGENCE CRITERIA

EAC partners States agreed to monitor the following indicative convergence criteria (i.e. early warning indicators): core inflation ceiling of 5 percent; fiscal deficit (excluding grants) ceiling of 6 percent of gross domestic product (GDP); and tax-to-GDP ratio of 25 percent.

However, macroeconomic convergence will be assessed on the following performance convergence criteria: headline inflation ceiling of 8 percent; fiscal deficit (including grants) ceiling of 3 percent of GDP; gross public debt ceiling of 50 percent of GDP in net present value terms; and reserve cover of 4.5 months of imports.

In this section, we analyze recent trends in the indicators pertaining to performance convergence criteria before we analyze other relevant factors as per the Optimum Currency Area (OCA) theory, such as economic structure, trade interdependence and business cycles.

An inspection of the EAC member countries' performance since 2000, relative to the convergence criteria, reveals disparities among countries despite some similarities in the structures of their economies. Each country's outcomes with respect to performance convergence criteria are reported in Table 1. In general, Partner States are on track of achieving the criteria on inflation. However, challenges remain in attaining the criteria on fiscal deficit and adequate level of foreign reserves.

3.1. Headline inflation ceiling of 8 percent

Movements in prices is one of the indicators of convergence that can be easily assessed. One issue merits consideration. In different prospect monetary unions, countries set a maximum acceptable level of inflation, such as 8 percent in EAC. However, a low level of inflation could be a cause of concern so that a deflationary bias in many countries would be a serious structural problem for a monetary union.

Two approaches have been used to assess how countries comply with the criteria on inflation. In addition to comparing countries' inflation rates against the convergence criteria, the standard deviation can be used to measure the dispersion between inflation rates. Increased integration between the member countries is likely to result in a reduction in the standard deviation over time. On the other side, significant differences between inflation rates can indicate that real exchange rates are diverging and affecting competitiveness. In addition, persistent differences in inflation among members of a monetary union may lead to disparities in real interest rates, given that the common monetary policy leads to same nominal interest rates. However, in the case of absence of exchange rate flexibility, inflation differentials can serve as adjustment mechanism, for countries with higher productivity or lower wage growth than others. Those countries would experience a depreciation of the real exchange rate and thus a gain in trade competitiveness.

As shown in table 1, average inflation rate in each EAC country during the period 2010–16 was in the single digits, however with disparities, varying from 4.1% in Rwanda to 8.7% in Tanzania. All countries complied with the inflation criteria of keeping headline inflation below 8% between 2010 and 2016, except for some years. In the period under review, Burundi and Tanzania missed the target twice, Uganda and Kenya once. In addition, inflation was less volatile in Rwanda, with a standard deviation (SD) of 1.7. It was more volatile in Burundi (SD=4.5), followed by Uganda (SD=4.3), Tanzania (SD=4.1) and Kenya (SD=3). The volatility in inflation rates is mainly due to supply shocks, particularly changes in food prices and also volatility in regional currencies' exchange rates due to external shocks and the structure of economies (e.g. the weight of the traded and non-traded sectors in GDP). Understanding the nature of shocks affecting EAC countries is important because of the observed differences in volatility in inflation and the important role played by exchange rates as source of disturbances to inflation.

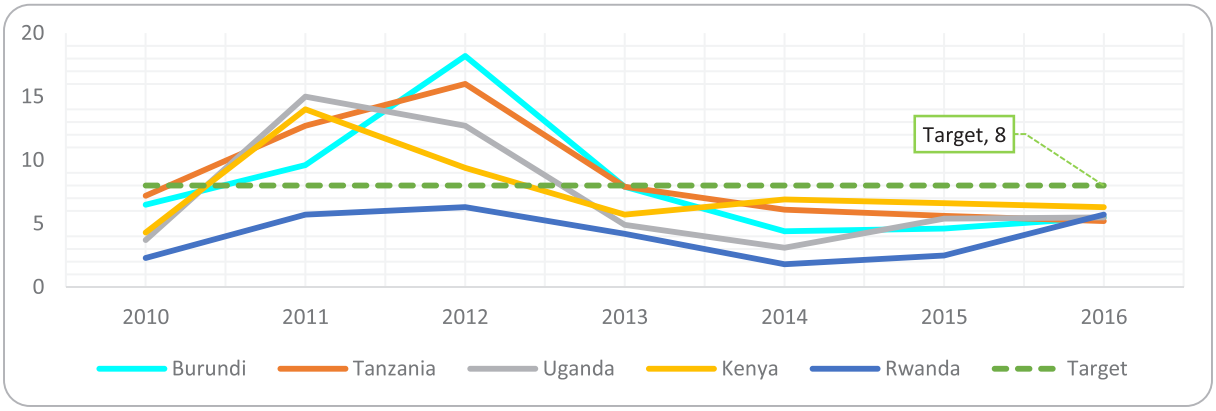
Table 1: EAC Macroeconomic convergence

Indicators	Country	2010	2011	2012	2013	2014	2015	2016	Average	SD
Inflation	Burundi	6.5	9.6	18.2	7.9	4.4	4.6	5.5	8.1	4.5
	Tanzania	7.2	12.7	16.0	7.9	6.1	5.6	5.2	8.7	4.1
	Uganda	3.7	15.0	12.7	4.9	3.1	5.4	5.5	7.2	4.3
	Kenya	4.3	14.0	9.4	5.7	6.9	6.6	6.3	7.6	3.0
	Rwanda	2.3	5.7	6.3	4.2	1.8	2.5	5.7	4.1	1.7
International Reserves (months of imports)	Burundi	4.1	3.2	3.4	3.4	3.5	4.2	1.9	3.4	0.8
	Tanzania	4.1	3.5	3.6	4.0	4.3	4.0	3.7	3.9	0.3
	Uganda	3.9	3.7	4.5	4.8	5.1	4.8	4.5	4.5	0.5
	Kenya	2.9	2.8	3.7	3.9	5.3	5.1	4.8	4.1	1.0
	Rwanda	5.2	6.5	5.6	4.8	3.9	3.5	4.0	4.8	1.1
Fiscal deficit, including grants (in % of GDP)	Burundi	-3.6	-3.9	-3.7	-1.7	-3.4	-5.3	-6.2		
	Tanzania	-4.8	-3.6	-4.1	-3.9	-3.0	-3.3	-3.8		
	Uganda	-5.8	-2.6	-3.0	-3.9	-3.3	-2.7	-3.6		
	Kenya	-4.4	-4.1	-5.0	-5.7	-7.4	-8.2	-7.3		
	Rwanda	-0.7	-0.9	-2.5	-1.3	-4.0	-2.8	-2.4		
Gross public debt (% of GDP)	Burundi	46.9	42.7	41.4	36.1	35.7	46.0	47.2		
	Tanzania	27.5	28.0	29.2	31.4	33.2	36.9	39.0		
	Uganda	23.6	23.3	24.6	27.4	30.1	33.2	36.9		
	Kenya	44.4	43.0	40.8	42.2	48.6	52.4	54.4		
	Rwanda	20.0	19.9	20.0	26.7	29.1	33.4	37.6		

Source: MAC, August 2017

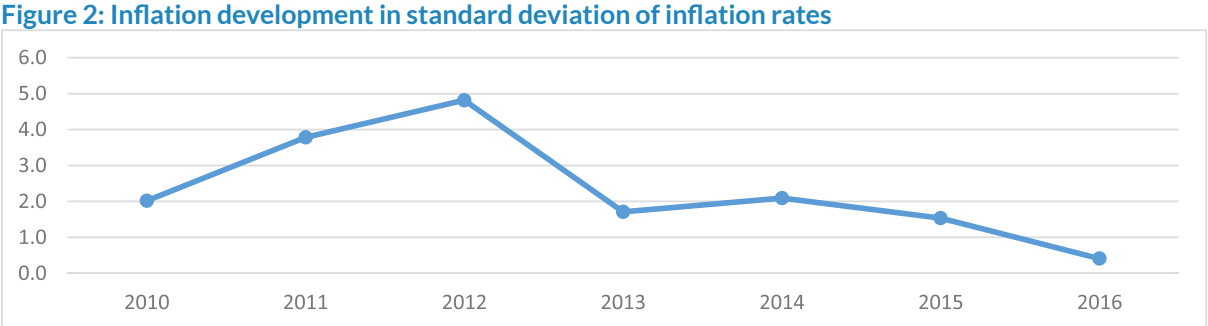
The graph below shows that inflation rates in EAC countries were usually higher in 2011 and 2012 due to high increase in food prices, but declined and remained lower than the target since 2013.

Figure 1: Inflation development in EAC



The cross-country standard deviation of EAC countries' inflation rates increased since 2010, reaching its maximum (4.8) in the 2012 before slowing down to 0.4 in 2016, indicating convergence in inflation rates during the recent period. High standard deviation in 2010- 2012 is an indication of how the five countries were differently affected by food prices shocks and external shocks.

Figure 2: Inflation development in standard deviation of inflation rates



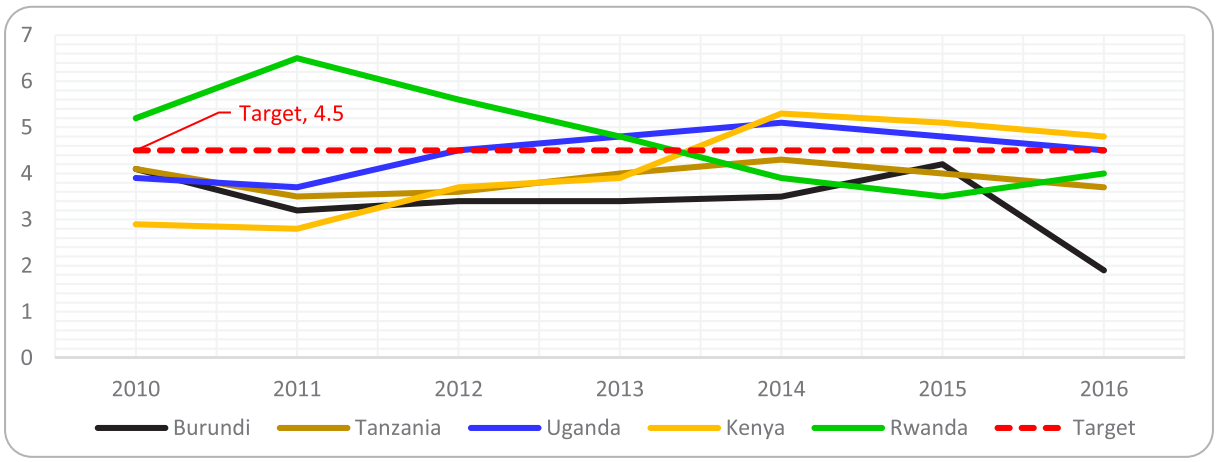
3.2. Reserve cover of 4.5 months of imports

To be protected against external shocks, EAC countries decided to hold foreign-exchange reserves covering at least 4.5 months of imports. Countries with adequate reserves generally avoid large drops in output and consumption when facing external shocks, such as trade shocks, volatile aid and foreign direct investment, and a decline remittance flows. Solid foreign reserves buffers, in conjunction with sound policies, can bring significant benefits by reducing the likelihood of balance of payments problems and ensuring economic and financial stability. That is why a regular forward-looking discussion on reserve adequacy is important as it ensures that anticipated changes in baseline external vulnerabilities are taken into account.

According to the IMF definition, reserves are fundamentally an external liquidity buffer and external assets for a country, that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes such as maintaining confidence in the currency and the economy, and serving as a basis for foreign borrowing (IMF, 2011).

The figure below shows that in the period 2010 and 2016, only Uganda complies with the criteria – with foreign reserves covering exactly 4.5 months of imports on average since 2012. The average level of coverage was 4.1 months of import in Rwanda and Kenya and 3.9 and 3.4 months in Tanzania and Burundi respectively.

Figure 3: International reserves-months of import



The literature on the need of keeping foreign reserves shows that lower levels of reserves are only admissible in countries with good institutions and policies (IMF, 2011).

The inability of keeping sufficient levels of foreign reserves can be an indication of economic problems, including a less diversified economic structure and balance of payments imbalances. Thus, EAC countries need to not only diversify their economies to generate more foreign reserves, but also ensure that they implement efficient policies and create sound institutions for better management of reserves - by clearly identifying responsibility and ensure accountability in the way reserves are effectively and efficiently managed to meet country's needs.

3.3. Fiscal deficit (including grants) ceiling of 3 percent of GDP and gross public debt ceiling of 50 percent of GDP (in net present value terms)

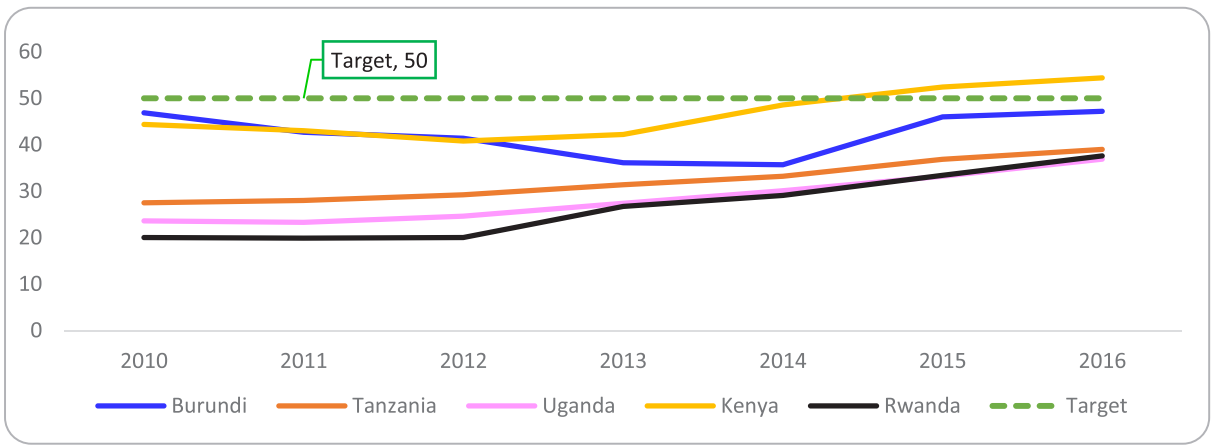
Convergence in fiscal policies is important for the viability of a monetary union, because after adoption of a single monetary policy, national fiscal policy will become the main tool at the disposal of individual countries to respond to national economic shocks. However, the fiscal policy stance may differ considerably from a country to another and this has different implications for the monetary union. A country that runs a large budget deficit and borrows heavily from other member countries to cover the deficit could prevent funding from productive investments to the disadvantage of the monetary union as a whole.

In addition, if many members of a monetary union borrow significantly, this would be an indication of structural problems that could tighten investment in the private sector and possibly damage the long-term health of the union. Furthermore, disparities in government deficits could indicate that certain economies are drawing in investment capital to the possible detriment of other union members. In summary, in a monetary union, domestic fiscal policies can cause negative spillover effects on other members of the union.

The ratio of government debt to GDP, which is a function of the size of the fiscal deficit and GDP, is commonly used as convergence criteria – as it can provide information on long-term fiscal sustainability. Stable or declining ratios are considered desirable. High deficits can potentially cause unsustainable growth in the debt ratios, and thus the deficit and debt ratios must be monitored together.

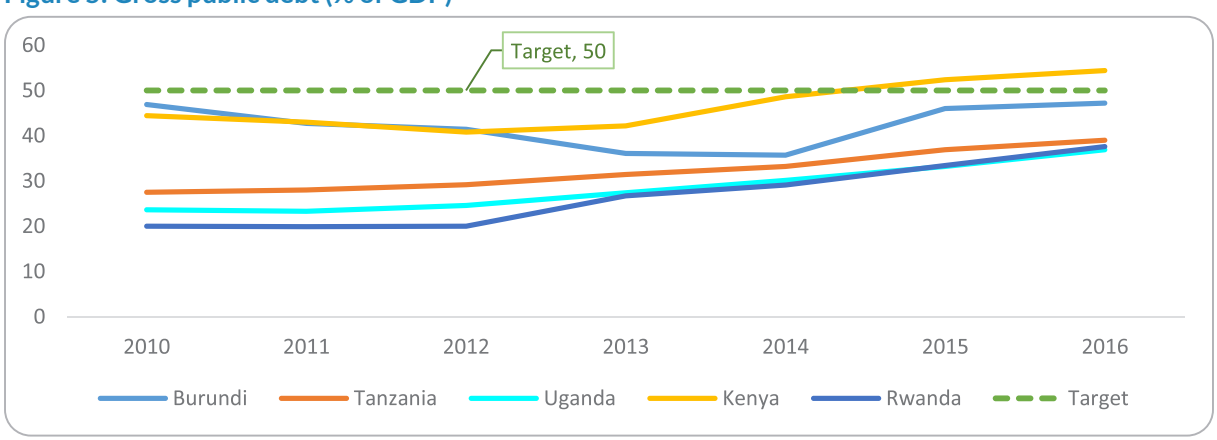
In EAC countries, overall fiscal and external deficits are sizeable, mostly reflecting large infrastructure spending and associated capital goods imports. All EAC countries complied with the criteria of gross public debt ceiling of 50 percent of GDP, except the recent case in Kenya where the ratio increased to 52.4% and 54.4% in 2015 and 2016, respectively. Furthermore, gross public debt as percentage of GDP has been increasing in all EAC countries in recent years, further placing pressures on government budgets and contributing to higher deficits (through higher debt interest payments).

Figure 4: Budget deficit as percentage of GDP



With regard to the fiscal deficit (including grants) not to exceed 3% of GDP, only Rwanda consistently complied with that criterion between 2010 and 2016. Considering the indicative convergence criteria about fiscal deficit (excluding grants) not to exceed 6 percent of GDP, some countries (such as Rwanda, Tanzania and Burundi) have consistently found it difficult to achieve. Combining the two criteria about fiscal deficit including or excluding grants, it becomes apparent that EAC countries' capacity to generate their own revenue remains low compared to their financial demands. The high dependency on grants and loans for economic development is risky for any economy, even more dangerous as nations join the union given that such donor support is not a sustainable source of financing for government expenditures.

Figure 5: Gross public debt (% of GDP)



As indicated, fiscal policy will be the main macroeconomic policy tool available to countries after giving up monetary policy sovereignty. In addition, the above analysis has shown that fiscal convergence is an area where EAC countries still have considerable challenges.

To achieve this objective, there is a need for EAC countries to agree on explicit and binding fiscal convergence commitments as prerequisites (and ongoing commitments) for the viability of EAMU. Complying with the fiscal convergence criteria is challenging considering the macroeconomic context of EAC countries, with significant need for public investment and development spending. In addition, the countries face significant macroeconomic shocks, such as terms-of-trade shocks from international commodity prices; agricultural productivity shocks from weather; and international aid shocks. Thus, sufficient discretion in national fiscal policy would better enable individual countries to respond to idiosyncratic shocks. This calls for not only for agreement on fiscal convergence criteria and commitment for fiscal discipline, but also the establishment of an independent institution or strong mechanism for enforcement and ensuring compliance by all countries.

Independence involves the personnel selection process, the EAC enforcement agency's budget, and the enforcement mechanism avoiding any political pressure. In addition to the establishment of East African Monetary Union (EAMU), it is urgent to fast track the establishment of the institution responsible for surveillance, compliance and enforcement as indicated in EAMU protocol.

History demonstrates that several approaches have widely been used to ensure fiscal discipline in monetary unions. These include centralized enforcement (e.g., EMU and WAEMU since 1999), surveillance and persuasion (e.g., ECCU and CEMAC), and decentralized enforcement (e.g., USA).

These approaches attempt to address the imperfect incentives facing governments when deciding about fiscal policy. For example, elected officials tend to have short time horizons and are tempted to increase borrowing to implement different projects and meet expectations of their constituencies. However, because in a monetary union the costs of borrowing are shared with other member states, elected officials in a member country are constrained in their decisions.

One method is to legally denounce bailouts, although difficult in practice. If a member of a monetary union is about to deny its debt, its creditors may be spread throughout the monetary union. Greece and Ireland are a case in point. Despite the Maastricht Treaty's "no-bailout" clause, the two countries received bailouts because in a monetary union where countries are more integrated, costs of not bailing out a country may eventually exceed the costs of bailing out that country.

A second method is to create a firm and categorical rule banning deficits and debt beyond a certain level. To ban behavior, the sanctions applied to non-compliant countries must be prohibitive. This approach has advantages because violations are easy to identify and are in general uniformly punished. However, during periods of economic hardship, these rules are also difficult to implement in a monetary union. They can prevent sound economic policies to limit the negative impact of economic problems of the concerned country. Thus, such rule is likely to face political resistance. In addition, in an integrated monetary union, the costs of not increasing budget deficits may spill over and affect other member states.

A third method might be enforcement with a more flexible, multifactor balancing test. This rule would allow the judge of excessive deficits to consider a country's circumstances to determine the economic

merits and demerits of a particular deficit. The big challenge related to this approach is that such rules rely heavily on the judge's subjective opinions and this can lead to disagreement among countries. The former East African Currency Board, which was in place from 1960 to 1966 and composed by Uganda, Kenya and Tanzania, is an example about the challenges associated to this approach. By 1964 both Tanzania and Uganda had reached their borrowing limits. The plan of the two countries to raise the limits and borrow more was constrained by Kenya's approval. This situation contributed to dissolving the monetary union within six years of its formation.

3.4. Other convergence indicators

3.4.1 Economic growth in EAC countries

The overall macroeconomic performance in EAC countries has been mixed. Kenya is the largest economy, accounting for an average of 38.4% per cent of total EAC GDP between 2000 and 2016, followed by Tanzania (34.1%), Uganda (20.1%), Rwanda (4.8%) and Burundi (2.4%). Kenya is also relatively industrialized and diversified, considered as the regional trade hub and its private enterprises lead intraregional investment. For example, Kenyan banks operate across the region, with subsidiaries in many EAC countries.

Between 2000 and 2016, average real economic growth rates ranged from 3.1% in Burundi to 7.9% in Rwanda (Table 2). During the last five years (2012-2016), real economic growth was not only low but very volatile in Burundi, averaging 2% with a standard deviation of 4.3. Average GDP growth rates remain higher in Rwanda (7.2%) followed by Tanzania (6.7%), Kenya (5.4%) and Uganda (4.1%). During that period, economic growth was less volatile in Kenya (SD=0.5) and Tanzania (SD=0.9).

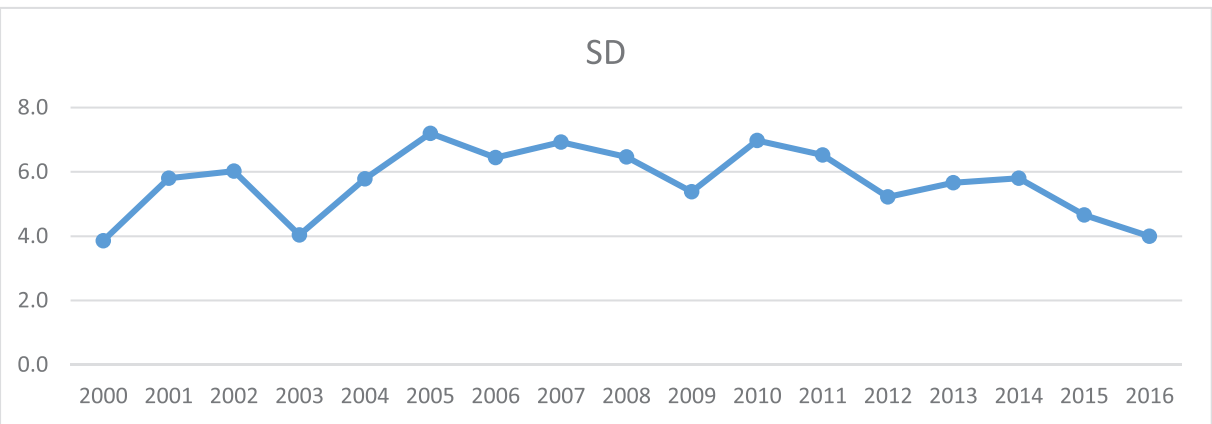
Table 2: real GDP growth

	Burundi	Kenya	Rwanda	Tanzania	Uganda
2000	1.8	0.3	8.4	4.9	3.9
2001	1.7	4.0	8.5	6.0	8.8
2002	2.4	0.5	13.2	6.9	7.1
2003	2.5	2.9	2.2	6.4	6.2
2004	3.8	4.6	7.5	7.2	5.8
2005	4.4	5.7	9.4	6.5	10.0
2006	5.4	5.9	9.2	4.7	7.0
2007	3.5	6.9	7.6	8.5	8.1
2008	4.9	0.2	11.2	5.6	10.4
2009	3.8	3.3	6.3	5.4	8.1
2010	5.1	8.4	7.3	6.4	7.7
2011	4.0	6.1	7.8	7.9	6.8
2012	4.4	4.6	8.8	5.1	3.2
2013	5.9	5.7	4.7	7.3	4.7
2014	4.5	5.3	7.6	7.0	4.6
2015	-4.0	5.7	8.9	7.0	5.7
2016	-1.0	5.8	5.9	7.0	2.3
Average	3.1	4.5	7.9	6.4	6.5
SD	2.5	2.3	2.4	1.1	2.3
AV5	2.0	5.4	7.2	6.7	4.1
SD5	4.3	0.5	1.8	0.9	1.3

SD: Standard deviation; AV5: average for the last five years; SD5: Standard deviation in the five years.

Additionally, the declining dispersion of growth rates across countries in the last years suggests only a gradual move toward economic convergence and indicates differences in real GDP growth.

Figure 6: Standard deviation of real GDP



Furthermore, the more similar the economic structures of the potential candidates for a monetary union are, so will be impacts of sector-specific shocks on their economies, and less national monetary policies are needed. As indicated in the table below, the weight of agriculture in total GDP remains high in all

EAC countries, but has declined over time, while the share of services in GDP has been increasing. That is an indication of progressive diversification in EAC economies. However, the industrial sector share in GDP remains low in all countries. This limits intra-regional trade of industrial products and increases the dependence of the region on manufacturing products from the rest of the world.

Table 3: GDP by economic activities (%)

		1990-1995	1996-2001	2002-2006	2006-2012	2012-2016
Agriculture	Burundi	50.8	46.4	38.8	36.1	36.1
	Kenya	30.1	31.7	27.9	23.0	22.3
	Rwanda	42.7	43.6	42.0	31.4	28.4
	Tanzania	44.8	44.1	44.3	25.3	24.6
	Uganda	50.1	38.6	32.0	24.6	22.9
Industry	Burundi	20.7	17.4	19.2	16.0	15.6
	Kenya	20.3	17.6	17.9	16.3	19.0
	Rwanda	21.2	19.0	20.0	15.1	16.9
	Tanzania	14.7	14.8	16.2	21.2	21.8
	Uganda	14.0	19.5	21.5	19.4	19.0
Services	Burundi	28.5	36.2	42.0	38.8	38.3
	Kenya	49.6	50.7	54.3	48.3	49.3
	Rwanda	36.1	37.4	38.0	45.1	47.6
	Tanzania	40.5	41.1	39.5	44.4	44.0
	Uganda	35.9	42.0	46.5	43.8	50.0

The table below shows negative correlations between Rwanda and Burundi, Rwanda and Kenya as well as between Rwanda and Tanzania. In addition, all coefficients of correlation are not significant, except between Kenya and Uganda. This suggests a lack of synchronization of shocks between member states.

Table 4: EAC GDP correlations 2010-2016

Correlations							
			Burundi	Kenya	Rwanda	Tanzania	Uganda
Spearman's rho	Burundi	Correlation Coefficient	1.00				
		Sig. (2-tailed)	.				
	Kenya	Correlation Coefficient	0.29	1.00			
		Sig. (2-tailed)	0.54	.			
	Rwanda	Correlation Coefficient	-0.61	-0.46	1.00		
		Sig. (2-tailed)	0.15	0.29	.		
	Tanzania	Correlation Coefficient	0.07	0.32	-0.18	1.00	
		Sig. (2-tailed)	0.88	0.48	0.70	.	
	Uganda	Correlation Coefficient	0.14	0.82*	0.00	0.36	1.00
		Sig. (2-tailed)	0.76	0.02	1.00	0.43	.

*. Correlation is significant at the 0.05 level (2-tailed).

3.4.2. Intra-regional trade

According to the OCA theory, countries with intense trade linkages among themselves could benefit from the introduction of a common currency. Table 5 shows the extent of intra-regional trade among the EAC countries. Trade linkages between EAC countries (i.e. the proportion of imports and exports to EAC countries as a share of total imports and exports of individual member countries) has been increasing overtime due to the implementation of common market protocol, but remain low.

Total intra EAC trade increased by 151.7%, from USD 2137.34 million in 2006 to USD 5380.31 million in 2015, but with significant disparities among EAC countries. Kenya accounts for 35.6% of total inter EAC trade (61.4% of exports and 14.9% of imports) followed by Uganda which accounts for 28.1% (13.1% of exports and 19.6% of imports), Tanzania accounting for 19.9% (22% of exports and 31.8% of imports), Rwanda accounting for 12.5% (3% of exports and 25.2% of imports) and Burundi accounting for only 3.9% (0.5% of exports and 8.4% of imports).

Data on intra EAC trade show that Kenya plays an important role in EAC trade as confirmed by its share of exports to other EAC members. For Rwanda, Burundi and Uganda, Kenya's markets represent an important source of imports. In addition, imports of Kenya from the other EAC members are negligible.

On the other side, Tanzanian trade with the other EAC members is quite low. This can be explained by the lack of adequate infrastructure between Tanzania and the other EAC members and the fact that Tanzanian trading relations are carried out mostly by sea and with SADC countries.

Despite the relatively large volume of trade among the EAC countries, significant challenges to regional integration remain, including the following: (i) low per capita income levels, resulting in internal markets of limited sizes; (ii) the concentration of most countries on primary-commodity exports; (iii) limited transportation facilities and large distances between population centers; and, (iv) relatively-high shares of informal trade because of permeable borders.

Table 5: Trade with other EAC members (% total)

	Burundi		Tanzania		Uganda		Rwanda		Kenya	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
2006	9.2	13.8	7.9	4.5	22.3	16.8	25.6	44.6	21.3	1.1
2007	9.7	25.7	10.3	1.9	22.6	13.5	25.5	42.9	23.2	2.1
2008	9.5	21.0	8.3	3.0	26.4	12.7	17.2	40.7	23.6	1.6
2009	8.8	32.1	10.8	4.9	25.3	12.7	24.6	36.6	26.2	1.6
2010	12.4	17.6	9.9	3.7	28.3	12.1	21.3	37.1	24.7	2.1
2011	19.7	35.3	8.7	3.4	25.8	12.7	20.8	24.8	26.8	2.0
2012	11.9	19.6	9.7	5.8	27.1	11.1	23.9	24.2	26.1	2.2
2013	17.2	38.0	21.6	3.2	27.7	11.0	21.5	23.0	24.9	2.0
2014	10.9	21.4	10.5	5.6	29.8	11.8	23.8	22.9	23.4	2.3
2015	11.8	19.3	12.7	2.7	34.1	12.1	21.5	22.5	21.8	2.5

Source: EAC, Facts and Figures, 2016

4. EMPIRICAL ANALYSIS

In this paper, the empirical analysis of the readiness of EAC countries to form a monetary union is based on three two different methodologies. First, we analyze correlations of shocks identified using a three-step autoregressive estimation procedure, as well as a Vector Auto Regressive (VAR) model. Second, we use multivariate cointegration techniques to assess the existence of long-term relationships for key variables across countries – such as inflation rates, exchange rates and interest rates.

4.1. Three Step Auto Regressive procedure

Following Bayoumi and Ostry (1997), we use a three-step autoregressive estimation procedure. First, for each country we regress the change in the logarithm of real GDP (y_t) upon its own first and second lags as follow

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \varepsilon_t$$

Second, we obtain the residuals from this regression (e_t) and consider them as underlying real output disturbances. Third, we calculate correlations of real output disturbances among EAC countries.
Table 8 shows that the underlying real output disturbances are negative in general, showing non-synchronization of shocks, except between Kenya and Tanzania and between Tanzania and Uganda, although the coefficient is very small for the latter. The correlations reported do not support the assumption that EAC is an optimum currency area.

Table 6: Correlations of EAC real output disturbances

	Burundi	Kenya	Rwanda	Tanzania	Uganda
Burundi	1				
Kenya	-0.04	1			
Rwanda	-0.15	-0.01	1		
Tanzania	-0.05	0.72	-0.19	1	
Uganda	0.10	0.02	-0.00	0.13	1

4.2 Vector Auto regressive (VAR) models

We estimate a bivariate vector-autoregressive (VAR) model using the log of real GDP and inflation, adopting the identification scheme due to Blanchard and Quah (1989) to separate supply and demand shocks in EAC countries. In this scheme, permanent shocks are interpreted as aggregate supply shocks, and transitory shocks as aggregate demand shocks.

The model is set up as follows:

$$\text{Let } y_t = (\Delta y_{1t}, y_{2t})' \qquad (1)$$

Where y_{1t} is the log of real GDP and hence Δy_{1t} is the growth rate of real output, and y_{2t} is the inflation

rate, which is calculated as the change in the logarithm of the consumer price index. The specification of the structural model is presented in annex 2.

In order to extract structural shocks, we estimated the VAR for each country. The number of lags to be used is determined by the AIC and BIC lag length criteria. Unit root tests were carried out on the logs of real GDP and CPI using the Augmented Dickey-Fuller test. Both log of real GDP and log of CPI are found to be I(1). As inflation (i.e. the change in the log of CPI) is I(0) in each country, the log of real GDP was therefore first-differenced before it could be used in a VAR model.

Before using the estimated models to separate demand and supply shocks, we analyzed the quality of those VAR models. First, all VAR models satisfy the stability condition as no root lies outside the unit circle. Second, residuals from VAR models are homoscedastic and are normally distributed, except in the case of Rwanda and Burundi. However, in the two cases, the normality is violated due to excess kurtosis rather than skewness and this is not expected to much impact our results (Gonzalo, 1994).

The long-run impact matrix, which is used to identify the B matrix in a structural VAR as defined in equation (7), was estimated for each country as follow. The table below indicates the estimated matrix

$\theta(1) = \begin{pmatrix} 0 & C(2) \\ C(1) & C(3) \end{pmatrix}$; where C(1)= $\theta_{21}(1)$; C(2)= $\theta_{12}(1)$ and C(3)= $\theta_{22}(1)$, $\theta_{ij})$ (1) are defined in the equation (7).

Table 7: Estimated coefficients C (i)

	Coefficient	Std. Error	z-Statistic	Prob.
Rwanda				
C(1)	9.51	1.04	9.16	0.00
C(2)	0.011	0.00	9.16	0.00
C(3)	1.30	1.47	0.88	0.38
Uganda				
C(1)	8.23	0.908746	9.05	0.00
C(2)	0.01	0.000930	9.05	0.00
C(3)	-0.86	1.288706	-0.67	0.50
Kenya				
C(1)	3.96	0.44	9.05	0.00
C(2)	0.01	0.00	9.05	0.00
C(3)	-4.49	0.79	-5.66	0.00
Tanzania				
C(1)	8.61	0.94	9.16	0.00
C(2)	0.02	0.00	9.16	0.00
Burundi				
C(3)	-2.45	1.35	-1.81	0.07
C(1)	18.52	2.00	9.27	0.00
C(2)	0.02	0.002582	9.27	0.00
C(3)	12.57	3.132252	4.01	0.00

As shown in the table 8, demand shocks correlations are not statistically significant. In addition, the results indicate that the correlations are mostly positive, with a few exceptions.

Table 8: Correlations of demand shocks

Correlations							
			Burundi	**Kenya**	**Uganda**	**Tanzania**	**Rwanda**
Kendall's tau_b	Burundi	Correlation Coefficient	1.000				
	Kenya	Correlation Coefficient	-0.02	1.00			
	Uganda	Correlation Coefficient	0.17	0.10	1.00		
	Tanzania	Correlation Coefficient	-0.01	0.17	0.06	1.00	
	Rwanda	Correlation Coefficient	-0.13	-0.12	0.04	0.05	1.00

Contrary to demand shocks, supply shocks correlations are positive and statistically significant, though often small. Supply shocks in Kenya are positively and significantly correlated with shocks in all other EAC countries; Supply shocks in Rwanda are positively and significantly correlated with supply shocks in Burundi and Tanzania and Kenya.

Table 9: Correlations of supply shocks

Correlations							
			Burundi	**Kenya**	**Uganda**	Tanzania	Rwanda
	Burundi	Correlation Coefficient	1.000				
	Kenya	Correlation Coefficient	0.24*	1.000			
	Uganda	Correlation Coefficient	0.19	0.39**	1.00		
	Tanzania	Correlation Coefficient	0.17	0.40**	0.21	1.00	
	Rwanda	Correlation Coefficient	0.37**	0.22*	0.17	0.31**	1.00
*. Correlation is significant at the 0.05 level (2-tailed).							
**. Correlation is significant at the 0.01 level (2-tailed).							

Tables 8 and 9 show that correlations of demand shocks are very low and not significant while correlations of supply shocks (though not high) are significant between Kenya and the rest of countries, between Rwanda and Burundi, as well as between Rwanda and Tanzania. Significant supply shocks pose greater problems for a monetary union because demand shocks can be expected to become more similar with a monetary union, while supply shocks cannot. Analysis of demand and supply shocks indicates that at this stage, all EAC countries should not form a monetary union.

4.3. Multivariate Cointegration framework

A multivariate cointegration framework (Johansen, 1994; Johansen, 1995) is used to test the existence of long-run relationships that tie together variables in each criterion across EAC countries. Because convergence implies co-movements of specific variables over time, the cointegration approach is well-suited to assess the feasibility of an EAC monetary union. Based on a separate model set up for each variable (namely, inflation rates and exchange rates), full convergence would be achieved if there are (n-1) cointegrating equations or shared common trends, with 'n' being the number of variables included in the cointegrated VAR (CVAR) model.

In time series econometrics the assumption of stationary data needs to be fulfilled so that estimation properties hold. As the variables we consider here are generally assumed to be non-stationary (i.e. integrated of first order), a cointegration approach is not only appropriate but also allows to find out if common stochastic trends drive the different variables over the long run. If that is the case, linear combinations of the considered variables will appear stationary as the stochastic properties cancel out. These combinations represent long run relationships in the data and indicate the level of convergence that exists among the variable. Let us assume we have p=5 variables such as monthly inflation data of Burundi, Kenya, Rwanda, Tanzania and Uganda and r is the number of cointegrating vectors. Assuming that there is no cointegration relationship (r=0), this indicates that all variables are driven by individual stochastic trends, hence the whole system is driven by p-r=5 "common" trends. In that case, no convergence is found and countries may not be good candidates for a monetary union.

If we find r=4 (i.e. p-r=1), that would mean that all variables are driven by the same stochastic trend and full convergence among the variables is achieved. Supposing r=3, variables are driven by 2 (p-r=2) common trends and we only have partial convergence. In the next sub-section we outline the procedure how the number of cointegrating relationships can be identified.

4.3.1. Model specification

First, we have set up a well-specified vector autoregressive (VAR) model for each group of variables, as we are interested in the stage of convergence among inflation rates, exchange rates and lending rates in the EAC countries. In the analysis, we present various models were a vector consists of the same variable (e.g. inflation rates or exchange rates) across the different countries. The specification of each model must ensure that residuals are neither auto correlated nor violate the normality assumption. Thus, each model requires a sufficient but parsimonious number of lags, k, to account for the dynamics in the variables. Moreover, certain time dummies need to be specified so that large outliers do not affect the results.

The general autoregressive model can be presented in the form of a multivariate vector error correction model (VECM):

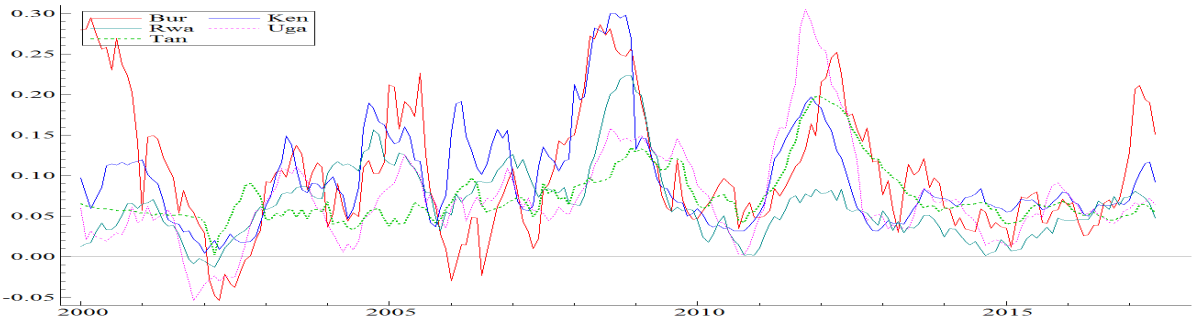
$$\Delta x_t = \delta + \gamma * t + \pi x_{t-1} + \sum_{i=1}^{k-1} \theta_i \Delta x_{t-i} + \vartheta D_t + \varepsilon_t \qquad (9)$$

where x_t represents a vector of iid error terms and are coefficient matrices. The vector includes dummies for observations where the absolute residual is larger than 3.5 standard deviations to ensure valid statistical inference. For more details about the identification of number of cointegrating vectors or common trends, see the annex 1.

4.3.2 Analysis of convergence among inflation rates in EAC countries

Monthly data on the national consumer price level index between January 2005 and June 2017 has been provided by the national central banks. We have extended by using additional data from the International Monetary Fund (IMF) from January 2000 to December 2004. Monthly year-on-year inflation rates are depicted in Figure 7 below.

Figure 7: Development in EAC inflation rates



First, we analyze convergence only among Kenya, Tanzania and Uganda, the founders of EAC. In this case, p=3. The Akaike criteria suggests 6 inflation lags in the VAR model, which is confirmed by the likelihood ratio test for the lag structure.

Moreover, 10 impulse dummies are required to eliminate large outliers (the rank test, cointegration relationships, and restrictions are robust to lag length chosen and full exclusion of dummies). Both, the time trend and seasonal dummies are insignificant and are removed from the analysis. Moreover, the constant in the VECM is restricted to only appear in the cointegration space, such that it does not accumulate over time.

Table 10: Trace tests for cointegration

I(1) ANALYSIS using the simulated asymptic distribution:

p-r	r	Eigenvalue	Trace	Trace^	Crit*5%	p-value*	p-value*^
3	0	0.1972	58.23	53.98	34.23	[0.000]	[0.000]
2	1	0.0412	13.41	12.93	20.24	[0.330]	[0.366]
1	2	0.0234	4.84	4.51	9.59	[0.305]	[0.342]

Crit*5% and p-value* are from the simulation.
p-value*^ incorporates the Bartlett small sample correction.

The asymptotic distribution of the trace test has been simulated to account for included dummy variables. The trace test indicates that the null hypothesis of no cointegration relationship among the variable is clearly rejected, while imposing a rank of r=1 on the pi matrix appears correct. The existence of one cointegrating relationship among the three countries is an indication that there is partial convergence in inflation rates, since we have two common trends (p-r=2).

The matrices and are thus of dimension 3*1 and their estimated coefficients are as follows.

Table 11: Estimated matrices alpha and beta

```
beta', the normalized cointegrating vectors:
                  Ken_1       Uga_1       Tan_1    Constant
     CVec(1)       0.14      -0.937           1     -0.0209
   {t-value}       {1.6}     {-11.1}                  {-2.8}

alpha, the loadings on the cointegrating vectors:
              alpha[][0]
        DKen     0.0327
                   {0.9}
        DUga       0.19
                   {6.1}
        DTan    -0.0634
   {t-value}       {-2.8}
```

The adjustment coefficient to inflation in Kenya seems to be not significant, while inflation in Uganda and Tanzania do adjust to disequilibria in the cointegration relationship. A corresponding restriction to Kenya's alpha coefficient is accepted at a p-value of 0.39:

Table 12: Estimated matrices alfa and beta, with restriction on Kenyan inflation

```
beta', the normalized cointegrating vectors:
                  Ken_1       Uga_1       Tan_1    Constant
     CVec(1)     -0.167           1       -1.07      0.0242
   {t-value}      {-2.1}                 {-8.6}       {2.5}

alpha, the loadings on the cointegrating vectors:
             alpha[][0]
        DKen          0

        DUga     -0.174
                  {-6.1}
        DTan     0.0626
   {t-value}       {2.9}
```

Further restrictions are not possible. Since Kenya is the largest economy with a substantial share of its exports going to other EAC members while the import share is only limited, its weak exogeneity to the relationship seems reasonable. Tanzania might show less adjustment due to its limited trade relationship with the EAC, as indicated in the analysis of intra-regional trade. Furthermore, the unrestricted moving average representation confirms Kenya's dominant position:

Table 13: Moving average representation and decomposition of trend

```
THE MA-REPRESENTATION AND DECOMPOSITION OF THE TREND

alpha_ort', alpha orthogonal (transposed):
                    Ken          Uga          Tan
          CT1         1       -0.172            0
                                {-0.9}
          CT2         0        0.334            1
   {t-value}                     {2.4}

beta_ort_tilde, the loadings on the common trends:
                    CT1          CT2
          Ken      1.11         0.21
                  {10.9}        {0.8}
          Uga     0.288         1.05
                   {3.7}        {5.5}
          Tan     0.114        0.956
   {t-value}       {1.8}        {5.9}

C, the long-run impact matrix:
                    Ken          Uga          Tan
          Ken      1.11       -0.121         0.21
                  {10.9}       {-0.7}        {0.8}
          Uga     0.288        0.301         1.05
                   {3.7}        {2.3}        {5.5}
          Tan     0.114        0.299        0.956
   {t-value}       {1.8}        {2.7}        {5.9}
```

The first common trend is strongly affected by shocks to Kenya's inflation rate. Uganda seems particularly affected by it. The other common trend is a combination of shocks to inflation in Uganda and Tanzania, only those two countries are driven by these shocks. We can conclude that there is evidence of partial convergence among these three inflation rates.

Next, we extend our sample to cover the five EAC countries in the analysis (p=5), with the deterministic components as specified before. The summary of results on residual terms from the estimated VAR models are presented in table 1 in annex 2. They indicate that there is no residual autocorrelation. The test for normality and no-ARCH effects are violated, but the former is mainly caused by excess kurtosis, rather than skewness. Gonzalo (1994) shows that cointegration results are reasonably robust to both, ARCH and excess kurtosis. Thus, this should not be of concern. The trace correlation, a summary statistic of the overall fit, is reasonable at 0.51.

We follow the same procedure as in the case of the three founders of EAC countries presented above. The trace test for cointegration from a simulated asymptotic distribution are presented below

Table 14: VAR Residual tests

```
I(1) ANALYSIS using the simulated asymptic distribution:
 p-r   r  Eigenvalue     Trace    Trace^   Crit*5%  p-value* p-value*^
   5   0      0.2517    131.11    114.41     76.51   [0.000]   [0.000]
   4   1      0.1493     71.98     64.65     53.45   [0.000]   [0.003]
   3   2      0.1070     38.99     35.79     34.00   [0.012]   [0.030]
   2   3      0.0510     15.91     15.02     19.71   [0.163]   [0.209]
   1   4      0.0253      5.23      4.84      8.93   [0.250]   [0.290]
Crit*5% and p-value* are from the simulation.
p-value*^ incorporates the Bartlett small sample correction.
```

At the 5% significance level, the results identify r=3 cointegration relationships. As indicated, this show also a partial convergence among inflation rates in EAC countries as full convergence would require 4 cointegration relationship, or equivalently one common trend driving the system. Imposing this rank gives following coefficient estimates in and:

Table 15: Estimated matrices alfa and beta

beta', the normalized cointegrating vectors:

	Bur_1	Ken_1	Rwa_1	Tan_1	Uga_1	Constant
CVec(1)	0.0858	-0.141	0.319	1	-0.973	-0.0198
CVec(2)	-0.088	1	-0.968	0.184	-0.34	-0.0128
CVec(3)	-0.758	0.327	0.0326	1	-0.211	-0.0214

alpha, the loadings on the cointegrating vectors:

	alpha[][0]	alpha[][1]	alpha[][2]
DBur	-0.0956	-0.0616	0.192
	{-1.4}	{-0.9}	{4.7}
DKen	0.0262	-0.0372	0.0217
	{0.8}	{-1.1}	{1.0}
DRwa	-0.00542	0.129	0.016
	{-0.2}	{5.2}	{1.1}
DTan	-0.0764	0.0248	-0.00602
	{-3.8}	{1.2}	{-0.5}
DUga	0.167	0.0377	0.0202
{t-value}	{6.0}	{1.3}	{1.2}

As the cointegration relationships are ordered according to their degree of stationarity, we see that the first relationship seems to present the previously identified relationship between the three core countries. The second relationship seems to include at least Kenya and Rwanda, while the third suggest a relationship between Burundi and Tanzania, possibly also Kenya. The last relationship is the weakest. As before, Kenya's inflation does not adjust to other countries' inflation, while all other countries have at least one significant alpha coefficient. The table 2 in annex 2 presents some general test results.

All variables appear in at least one relationship, as no column in can be restricted to only zeros. Moreover, stationarity of any individual inflation rate is rejected. In line with what we concluded from the alpha matrix, Kenyan inflation does not seem to adjust to any divergence in the existing relationship, as all alpha coefficients can jointly be restricted to 0. Testing the restriction of a unit vector in alpha considers if this variable is the only one adjusting to a disequilibrium in one of the relationships. This test cannot be rejected for Burundi and Rwanda, which means that neither shocks to inflation in Burundi or Rwanda are affecting inflation rates in other EAC member states. Further restrictions were imposed on alpha and beta at a p-value of 0.4 to investigate how changes in inflation in one country affect inflation in other countries as indicated in the table 3 in annex 2 .

The first relationship is quite identical to the core country case, where only Tanzania and Uganda are error correcting. As anticipated the second relationship identifies a relation between the Rwandan and Kenyan inflation. Rwanda's inflation seems to respond to changes in Kenya inflation. The final relationship is similar to the previous, just for Burundi. The country seems to respond specifically to changes in Uganda and Kenya. It is striking that each relationship seems to be reflecting trade relationships. The Moving Average (MA) representation looks as follows:

Table 16: Moving average representation

alpha_ort', alpha orthogonal (transposed):

	Bur	Ken	Rwa	Tan	Uga
CT1	0	1	0	-0.419	-0.194
CT2	0	0.509	0	1	0.462

beta_ort_tilde, the loadings on the common trends:

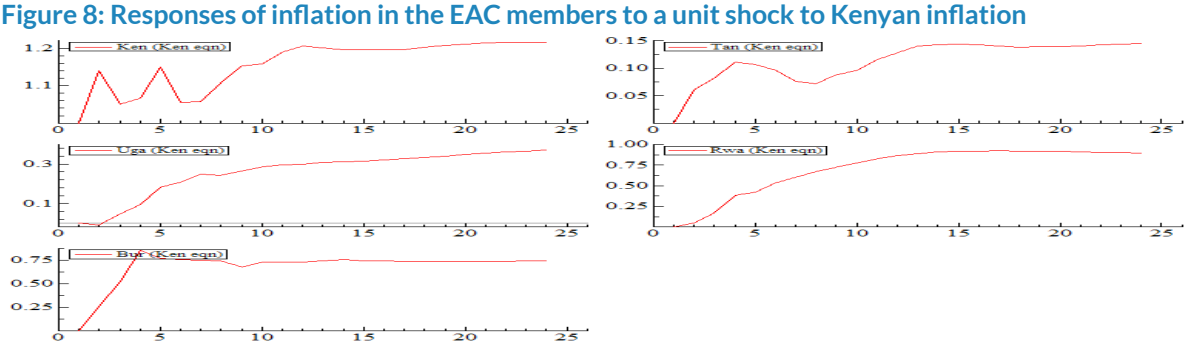
	CT1	CT2
Bur	0.3	0.832
Ken	0.967	0.449
Rwa	0.699	0.324
Tan	-0.226	0.724
Uga	-0.0794	0.834

C, the long-run impact matrix:

	Bur	Ken	Rwa	Tan	Uga
Bur	0	0.723	0	0.707	0.326
	{0.0}	{5.2}	{0.0}	{2.8}	{2.0}
Ken	0	1.19	0	0.0436	0.0201
	{0.0}	{7.3}	{0.0}	{0.1}	{0.1}
Rwa	0	0.864	0	0.0315	0.0145
	{0.0}	{7.3}	{0.0}	{0.1}	{0.1}
Tan	0	0.143	0	0.819	0.378
	{0.0}	{1.5}	{0.0}	{4.9}	{3.4}
Uga	0	0.345	0	0.867	0.4
{t-value}	{0.0}	{3.0}	{0.0}	{4.2}	{2.9}

The conclusion from the MA representation concerning the convergence among inflation rates in EAC is that the inflation rate in all countries are positively affected by a shock to Kenyan inflation, while shocks to Rwandan and Burundian inflation are only transitory. As expected from weak exogeneity analysis of Kenyan inflation, it is not pushed by any other shock than its own. Tanzania and Uganda seem to affect each other. The responses of inflation in the EAC members after a unit shock to Kenyan inflation look as follows:

Figure 8: Responses of inflation in the EAC members to a unit shock to Kenyan inflation

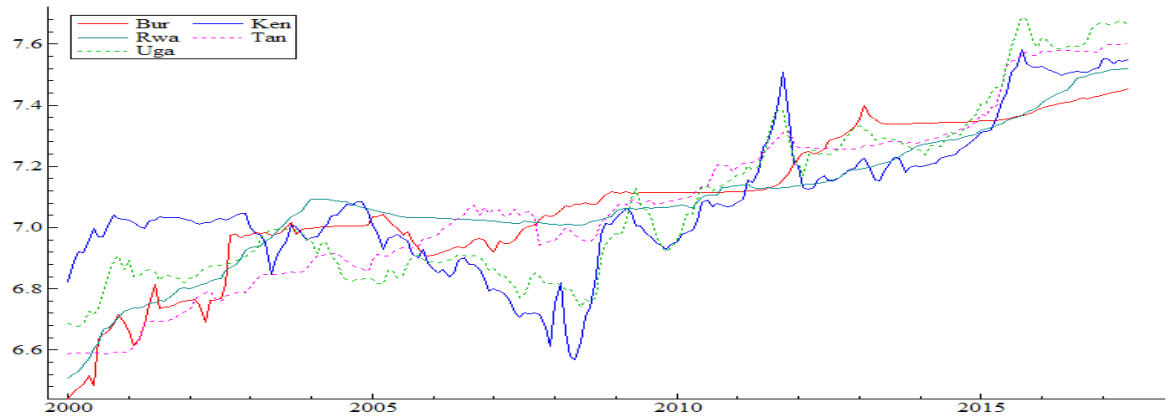


The analysis of cointegrating vectors between inflation rates shows partial convergence (in all cases, as we have found less than n-1 cointegrating vectors). This implies that the EAC countries will need to align and coordinate their monetary policies to foster convergence.

4.3.3. Analysis - Exchange rate (Local Currency Units/USD)

In this paragraph, we analyze convergence among nominal exchange rates in EAC countries. In this study, exchange rates are expressed as local currency units by one USD. Data are from regional central banks and the IMF, and they cover the period from January 2000 to June 2017. Logs of the exchange rate are presented in the figure below.

Figure 9: Development in nominal exchange rates in EAC



We specify a model for all 5 countries of the EAC. The Akaike criteria suggests k=2 lags in the VAR model, which the likelihood ratio test for the lag structure confirms. Moreover, seasonal dummies are included to eliminate large outliers (as their removal is highly rejected in a likelihood ratio test). However, in the VECM the trend is restricted to only appear in the cointegration space, such that it does not accumulate to a quadratic trend over time. It only appears in the cointegration space to account for potential different deterministic trends. The test summary is given by:

Table 17: Residual analysis

```
RESIDUAL ANALYSIS

Residual correlations and standard errors:
                    DBur          DKen          DRwa          DTan          DUga
        DBur           1
        DKen      0.0457             1
        DRwa        0.04        0.0837             1
        DTan      0.0209        0.0825        0.0618             1
        DUga      0.0629         0.315      -0.00324         0.192             1
        S.E.      0.0111        0.0118       0.00398       0.00997        0.0159

log(|Omega|)                              =     -46.59463
Information criteria: SC                  =     -27.40130
                      HQ                  =     -29.26506
                      AIC                 =     -30.53025
Trace correlation                         =     0.5986894

Tests for autocorrelation
LM(1):                      Chi^2(25) =    32.469 [0.1449]
LM(2):                      Chi^2(25) =    25.490 [0.4352]

Test for normality:         Chi^2(10) =    126.53 [0.0000]**

Tests for ARCH:
LM(1):                      Chi^2(225)=    260.05 [0.0543]
LM(2):                      Chi^2(450)=    577.85 [0.0000]**

Univariate statistics of residuals
                  Mean      Std.dev.       Minimum       Maximum          R^2
DBur           0.00000      0.011137     -0.038303      0.042528       0.74352
DKen           0.00000      0.011753     -0.034306      0.039062       0.62010
DRwa           0.00000     0.0039813     -0.015116      0.015321       0.59652
DTan           0.00000     0.0099674     -0.027212      0.037802       0.57959
DUga           0.00000      0.015899     -0.049778      0.057233       0.54570

             ARCH(2)   p-value    Normality   p-value     Skewness     Kurtosis
DBur          18.987   [0.000]       48.602   [0.000]     -0.14653       5.9323
DKen          13.913   [0.001]       17.260   [0.000]      0.29240       4.5412
DRwa          7.2730   [0.026]       38.752   [0.000]      0.31364       5.6551
DTan          3.1441   [0.208]       10.408   [0.005]      0.46473       4.0881
DUga          1.8819   [0.390]       10.174   [0.006]    -0.095677       4.0301
```

The asymptotic distribution of the trace test has been simulated to account for the included dummy variables. The test indicates the existence of one cointegration relationship, hence a rank of r=1. The matrices and are thus of dimension 5*1 and their coefficient estimates are as follows.

Table 18: Estimated matrices alfa and beta, with restrictions

```
beta', the normalized cointegrating vectors:
                 Bur_1       Ken_1       Rwa_1       Tan_1       Uga_1       Trend
     CVec(1)     -0.199       -0.62     -0.0925      -0.561           1     0.00056
   {t-value}      {-1.4}      {-6.4}      {-0.5}      {-3.2}                   {0.7

alpha, the loadings on the cointegrating vectors:
              alpha[][0]
        DBur     0.0565
                   {3.5}
        DKen     0.0159
                   {0.9}
        DRwa     0.0304
                   {5.2}
        DTan     0.0478
                   {3.2}
        DUga    -0.0557
   {t-value}      {-2.4}
```

All signs in alpha and beta indicate that there is overall convergence, as all coefficients have the expected sign and suggest error correction. However, the exchange rate of Rwanda and Burundi are not significant in the cointegration relationship and could probably be excluded. However, the removal of the two countries together is rejected at the 10% significance level.

Table 19: Tests of restrictions

```
TESTS OF RESTRICTIONS
Tests of variable exclusion:
    Test of Bur_1:          Chi^2(1)  =   1.5289 [0.2163]
    Test of Ken_1:          Chi^2(1)  =   6.5315 [0.0106]*
    Test of Rwa_1:          Chi^2(1)  =  0.15568 [0.6932]
    Test of Tan_1:          Chi^2(1)  =   6.0614 [0.0138]*
    Test of Uga_1:          Chi^2(1)  =   20.679 [0.0000]**
    Test of Trend:          Chi^2(1)  =  0.41107 [0.5214]
```

Since the Rwandan and Burundian exchange rates move most “trend-like”, the best option is to exclude the trend, as including both could lead to some degree of multicollinearity. Taking out the trend from the cointegrating space means that the deterministic trends among the exchange rates are similar and cancel out. Restricting the deterministic component solely to an unrestricted constant gives following results:

Table 20: Estimated matrices alfa and beta

```
beta', the normalized cointegrating vectors:
                  Bur_1       Ken_1       Rwa_1       Tan_1       Uga_1
     CVec(1)     -0.124      -0.626      -0.182      -0.447           1
   {t-value}      {-1.2}      {-6.5}      {-1.1}      {-5.2}

alpha, the loadings on the cointegrating vectors:
              alpha[][0]
         DBur     0.0554
                    {3.4}
         DKen     0.0134
                    {0.8}
         DRwa     0.0309
                    {5.3}
         DTan     0.0439
                    {3.0}
         DUga    -0.0599
   {t-value}      {-2.5}
```

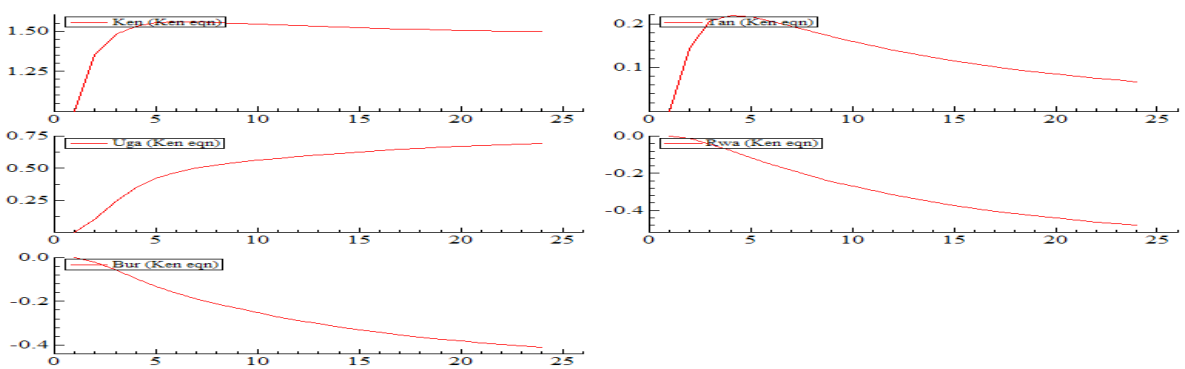
Again, it appears as if Kenya is the least error correcting. Furthermore, restricting the corresponding alpha coefficient to 0 cannot be rejected with a p-value of 0.46.

We have estimated the reaction of nominal exchange rates in EAC to one unit change in Kenyan shilling exchange rate with the USD. These impulse responses are presented in the figure below. A unit shock to Kenya exchange rate seems to affect Tanzania and Uganda in a similar way, while Rwanda and Burundi appear to withstand that shock. It could be that greater exchange rate management in those two countries are the underlying reason.

If the sample is restricted from 2005 onwards, there still strong evidence for one cointegration relationship. However, shock responses seem to become positive, even though Burundi and Rwanda still show the weakest response – which again seems to be well reasoned with their exchange rate management.

The conclusion from the MA representation concerning the convergence among exchange rates in EAC is that only Uganda and Tanzania are positively affected by a shock to Kenyan exchange rate. The response of exchange rates in Rwanda and Burundi still very weak due to limited flexibility in exchange rates in the two countries.

Figure 10: EAC exchange rates reaction to one unit change in Kenya shilling exchange rate



5. CONCLUSION AND POLICY RECOMMENDATIONS

The main objective of this paper was to investigate the readiness of the East African Community for a monetary union. EAC Partner States are in the process of implementing the Protocol on the Establishment of the East African Community Monetary Union (EAMU), which was signed in November 2013. It is expected that a common currency will be in use in the EAC by 2024. However, a common currency has its benefits and costs. The main benefits of a monetary union derive from the elimination of the transaction costs of exchanging currencies and the elimination of exchange-rate volatility. The main costs are those attributable to the inability of monetary authorities of the individual countries to use country-specific monetary policies and the exchange rate as an instrument of macroeconomic adjustment in response to shocks.

In fact, the benefits and costs arising from the establishment of monetary union depend on the structural characteristics of the economies concerned. While (endogenous) theory suggests that a common currency can promote trade and economic growth – and that countries could become more similar after joining a currency union - recent studies show little trade impact, particularly in developing countries. This reinforces the importance of meeting optimum currency criteria (OCA) as prerequisite for forming a currency union. The basic point of the OCA theory is that countries or regions exposed to symmetric shocks, or possessing mechanisms for the absorption of asymmetric shocks, may find it optimal to adopt a common currency.

First, we have assessed recent trends in the indicators pertaining to the performance convergence criteria before analyzing other relevant factors, as per the Optimum Currency Area (OCA) theory – such as economic structure, trade interdependence, and business cycles. Second, we have used different empirical techniques to identify possible convergence in EAC economies.

The general conclusion is that, despite some similarities in the structures of EAC economies, country-specific shocks have been prevalent – with countries remaining susceptible to asymmetric shocks. In addition, the empirical analysis suggests partial convergence among key macroeconomic variables used to assess the readiness of EAC countries for a monetary union.

Partial convergence in inflation and exchange rates implies that the EAC countries need to align their monetary policies and allow a period of monetary policy coordination to foster convergence that will improve the chances of a sustainable currency union. The transition to a monetary union is an important medium-to-long term goal for the EAC. In preparation, these countries have the opportunity to consider aspects of their economies that function as an effective conduit for monetary policy.

Therefore, it may be advisable for the region to fully implement the common market and customs union protocol, further harmonize policies and increase intraregional trade before adopting a common currency. The adoption of a common currency before reaching a greater level of convergence may be damaging to EAC countries. Moreover, it will be key for the EAC to continue to direct efforts to designing and establishing adequate mechanisms that can help member countries adjust to future shocks once the monetary union is established. This calls for a sufficient period of preparation before the establishment

of EAMU. A fast track process would lead to considerable costs for EAC countries[1]. Building effective institutions for enforcing fiscal discipline and enabling macroeconomic surveillance, structural reforms, development of necessary regional infrastructures and policy harmonization that would enhance business cycle management are essential in the EAC before the adoption of a common currency.

An inspection of the EAC member countries' performance since 2000, relative to the convergence criteria, reveals variations among countries. The cross-country standard deviation of EAC countries' inflation rates show some convergence during the recent period. However, inflationary pressures were observed in some countries, indicating that the five countries were differently affected by shocks, particularly food prices shocks and external shocks. In addition, standard deviations have indicated important volatility in some countries.

On the criteria of holding foreign-exchange reserves covering at least 4.5 months of imports, the assessment show that only Uganda complies with the criteria – with foreign reserves covering exactly 4.5 months of imports on average in the period 2010 and 2016. This shows that EAC countries are vulnerable to external shocks with potential negative impacts on macroeconomic stability. As a policy recommendation, EAC countries will need to adopt efficient policies and institutional frameworks to help clearly identify responsibilities, ensure good governance and accountability in the way that reserves are managed effectively and efficiently to meet country's needs, in addition to further develop and diversify their economies.

The assessment indicates that the overall fiscal and external deficits are sizeable in EAC countries, mostly reflecting large infrastructure spending and associated capital goods imports. Data show that fiscal convergence is an area where EAC countries still have considerable challenges. Indeed, complying with fiscal convergence criteria is not easy considering the macroeconomic context of EAC countries. EAC countries are developing economies with significant need for investment and development spending. In addition, the countries face significant macroeconomic shocks, such as terms-of-trade shocks from international commodity prices and agricultural productivity shocks from weather events. Furthermore, these shocks affect EAC countries differently. As a policy recommendation, EAC countries will need to agree to explicit and binding fiscal convergence commitments as prerequisites and ongoing commitments for the viability of EAMU. In addition to the commitment to fiscal discipline, there is a need for the establishment of an institution or strong mechanism for enforcing and ensuring compliance by all countries. The monetary union protocol provides for the establishment of an institution responsible for surveillance, compliance and enforcement. It is recommended to fast-track its implementation. In addition, the institution has to be independent from any political pressure. Independence may involve the personnel selection process, the EAC enforcement agency's budget and the enforcement mechanism.

The monetary affairs committee (MAC) of EAC Central Bank Governors has achieved important results in terms of harmonizing monetary and exchange rate policy formulation and implementation. Important achievements are also recorded in payment system development and harmonization as well as in the financial system stability and development. However, the absence of agreed rules and an enforcement mechanism poses challenges to the implementation of decisions by Governors, as well as decisions by other committees of the EAC. Indeed, policy coordination becomes problematic in the absence of a rule-based framework that engenders discipline among members and reduces the risk of bad policies. The recent

[1] The euro's success has stimulated interest in monetary unions in other regions. However, it took many years for the EMU to be established, despite less fiscal problems and credible institutions with competent bureaucracies that cooperated closely for more than 50 years.

euro zone debt crisis is a good example of weakly enforced rules and inadequate policy coordination. The lack of firm commitment to implement decisions taken by different regional committees to fast-track the implementation of the EAMU protocol due to more focus on relative national gains and sovereignty is one of the big challenges in the journey towards full regional integration.

Unfortunately, the establishment of institutions to support the implementation of the EAMU protocol has been delayed due to the lack of clear commitment by partner states. The East African Monetary Institute was supposed to be established in 2015, but the bill for its establishment is not yet ratified by the competent authorities. The experience of the European Monetary Union shows that the European Monetary Institute (EMI) played a crucial role in the establishment of the monetary union by spearheading the harmonisation of policies, monitoring and convergence criteria, standardisation of statistical procedures and the conduction of relevant studies. As a recommendation, it is very urgent to fast track the establishment of the East African Monetary Institute (EAMI) so as to benefit from the crucial role it would play.

Despite the relatively large volume of trade among EAC countries, significant challenges to regional integration remain, including the following: (i) low per capita income levels, resulting in internal markets of limited sizes; (ii) the concentration on primary-commodity exports for most countries; (iii) limited transportation facilities and large distances between population centers; and, (iv) relatively-high shares of informal trade because of permeable borders. In the process of enhancing regional integration through the increase of intraregional trade, it is important to fully implement the common market and customs union protocols. As a policy recommendation, barriers to trade within EAC need to be completely eliminated, while common policies toward the outside of the EAC should be adopted. The region's trade agenda therefore has a wider scope than just reducing intraregional tariff barriers. Its current primary focus is on removing structural – mostly non-trade – barriers to competitiveness and trade. Besides its traditional objectives (removing quotas and tariffs), trade policy of the EAC now strives to strengthen the members "soft" and "hard" infrastructure so as to enable them to leverage their relative comparative advantages. The focus on relative comparative advantages would also help diversify the EAC product mix and could enhance the scope for intraregional trade along the value chains.

Another important issue is the measurement of the convergence criteria. Because these criteria ought to have a legal force and be used as criteria for admission to the monetary union (or sanctioning member countries that fail to meet the criteria), a strong emphasis has to be placed on the quality and cross-country comparability of statistics. Therefore, statistical standards aligned with international statistical reporting requirements are needed and statistics must be transparent and suitable for a wide range of analyses and public purposes.

In their last meeting, held in September 2017, EAC central banks' Governors noted that the measurement of some indicators used to assess convergence criteria needs to be harmonized for comparability purpose (MAC, 2017).

The assessment carried out in this paper was based on recent experience, while planning for establishing a monetary union is a forward-looking assessment. We have observed what appears to be long-term structural differences. However, they may disappear in the run up to the establishment of the monetary union. Moreover, the observed asymmetric shocks could be policy-induced, rather than exogenous. In that case, the loss of policy independence as a member of the monetary union may not necessarily be costly. However, EAC countries will likely continue to be exposed to these shocks for some time, requiring policy responses. Going forward, as highlighted by the experience in other currency unions, it will be key for the

EAC to continue to direct efforts to designing and putting in place adequate mechanisms that can help member countries adjust to future shocks once the monetary union is created. This includes the usual measures to mitigate costs of common monetary policy, such as labor and capital mobility, price and wage flexibility, as well as various risk-sharing mechanisms - including fiscal. These measures should be agreed among member countries before the introduction of the single currency to reduce risks and signal early commitment to macroeconomic stability. As earlier highlighted, this will be possible if countries agree and strictly commit to rules and an enforcement mechanism for the implementation of different actions. Firm commitment, discipline among members, and reduction of the risk of bad policies are results of a rule-based framework.

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ANNEX 1: MULTIVARIATE COINTEGRATION FRAMEWORK

The general autoregressive model can be presented in the form of a multivariate vector error correction model (VECM):

$$\Delta x_t = \delta + \gamma * t + \pi x_{t-1} + \sum_{i=1}^{k-1} \theta_i \Delta x_{t-i} + \vartheta D_t + \varepsilon_t \qquad (9)$$

where represents a vector of iid error terms and are coefficient matrices. The vector includes dummies for observations where the absolute residual is larger than 3.5 standard deviations to ensure valid statistical inference. The matrix is of our most interest, as it includes the stationary relationships in vector . If has reduced rank, such that 0 < r < p, can be decomposed into where both and are matrices of dimension p*r. The reduced rank r indicates how many stationary relationships exist in the model. Since our variables are integrated of order one[2], all first difference components in the regressions (9) are I(0) and so are the r stationary linear combinations in . Thus, the crucial stationary assumption in time series econometrics is restored. The matrix depicts the adjustment coefficient matrix. It indicates how much a variable responds to a disequilibrium in the r long run relationships.

Johansen (1988) developed the so-called trace test, a likelihood ratio test, that allows to identify the reduced rank r (i.e. the number of cointegration relationships). The test compares different restricted models, let us call these H(r), to the unrestricted VAR model with full rank, H (p). The p-value of the test shows if a certain rank restriction is allowed or rejected.
If H(0) is not rejected, this indicates that a stationary relationship has been excluded and the assumption of no cointegration relationship is rejected. In that case, the second step will be to test H(1) vs H(p). Only when the test is accepted at a large enough p-value, we can be sure that no extra stationary relationship is left out and corresponding rank is imposed on π .

RESTRICTION IN ALPHA AND BETA

Once the correct rank is found and imposed, we can continue to identify the relationships by imposing and testing restrictions on the two matrices alpha and beta. A likelihood ratio test allows to test restrictions on the matrix and see which variables can be excluded from a cointegration relationship (see Johansen & Juselius, 1992). If a restriction is rejected it indicates that it significantly degrades the stationarity assumption of that relationship.

Likewise, restrictions on the can be tested. If an entire row in the matrix can be restricted to only include zeros, we can interpret it in a way that this variable does adjust to a disequilibrium (i.e. error-correct) in any cointegration relationships. Instead, it is only considered as “pushing” variable which drives the system and is not affected by it.

Long run impact of shocks from the Moving Average (MA) representation

A model with reduced rank can be inverted into its moving average representation. This is helpful as it shows us which stochastic trends drive the system. Thus, we can identify what effect a shock to a certain variable in one country has on the same variable in another country. Specifically, we are interested how a shock to Kenya, the strongest economy in the sample, affects the other member states.

[2] Inflations rates in EAC, extended to a long simple are tested to I(1)

ANNEX 2: COINTEGRATING VECTORS BETWEEN INFLATION RATES IN THE 5 EAC COUNTRIES

Table 1: VAR Residual tests

```
log(|Omega|)                          =     -45.78407
Information criteria: SC              =     -26.25049
                      HQ              =     -28.23606
                      AIC             =     -29.58488
Trace correlation                     =     0.5132458

Tests for autocorrelation
LM(1):                    Chi^2(25) =    27.138 [0.3490]
LM(2):                    Chi^2(25) =    27.069 [0.3525]

Test for normality:       Chi^2(10) =    52.086 [0.0000]**

Tests for ARCH:
LM(1):                    Chi^2(225)=    273.85 [0.0144]*
LM(2):                    Chi^2(450)=    537.69 [0.0028]**

Univariate statistics of residuals
               Mean      Std.dev.       Minimum       Maximum          R^2
DBur        0.00000      0.022595     -0.065370      0.086235      0.38939
DKen        0.00000      0.011415     -0.037271      0.044271      0.68400
DRwa        0.00000     0.0081313     -0.019443      0.024718      0.52201
DTan        0.00000     0.0067876     -0.019965      0.024153      0.43921
DUga        0.00000     0.0093807     -0.025616      0.027254      0.61941

            ARCH(2)  p-value    Normality  p-value     Skewness     Kurtosis
DBur         15.250  [0.000]       11.988  [0.002]      0.31130       4.2203
DKen         10.074  [0.006]       25.837  [0.000]      0.29508       5.0338
DRwa        0.80854  [0.667]       1.4506  [0.484]      0.17682       2.7886
DTan         14.269  [0.001]       21.046  [0.000]    -0.011114       4.6598
DUga         4.6148  [0.100]     0.039986  [0.980]    -0.020025       2.9287
```

Table 2: Tests of restrictions

```
TESTS OF RESTRICTIONS
Tests of variable exclusion:
    Test of Bur_1:            Chi^2(3)  =    11.391 [0.0098]**
    Test of Ken_1:            Chi^2(3)  =    18.610 [0.0003]**
    Test of Rwa_1:            Chi^2(3)  =    24.634 [0.0000]**
    Test of Tan_1:            Chi^2(3)  =    27.346 [0.0000]**
    Test of Uga_1:            Chi^2(3)  =    44.917 [0.0000]**
    Test of Constant:         Chi^2(3)  =    5.3362 [0.1488]
Tests of variable stationarity (keeping other restricted variables):
    Test of Bur_1:            Chi^2(2)  =    7.3111 [0.0258]*
    Test of Ken_1:            Chi^2(2)  =    16.257 [0.0003]**
    Test of Rwa_1:            Chi^2(2)  =    16.483 [0.0003]**
    Test of Tan_1:            Chi^2(2)  =    13.632 [0.0011]**
    Test of Uga_1:            Chi^2(2)  =    15.220 [0.0005]**
Tests of long-run weak exogeneity:
    Test of DBur:             Chi^2(3)  =    13.186 [0.0043]**
    Test of DKen:             Chi^2(3)  =    2.3009 [0.5124]
    Test of DRwa:             Chi^2(3)  =    20.809 [0.0001]**
    Test of DTan:             Chi^2(3)  =    12.478 [0.0059]**
    Test of DUga:             Chi^2(3)  =    29.013 [0.0000]**
Tests of unit vector in alpha:
    Test of alpha[][0]:       Chi^2(2)  =   0.91505 [0.6328]
    Test of alpha[][1]:       Chi^2(2)  =    17.748 [0.0001]**
    Test of alpha[][2]:       Chi^2(2)  =    3.0783 [0.2146]
    Test of alpha[][3]:       Chi^2(2)  =    10.816 [0.0045]**
    Test of alpha[][4]:       Chi^2(2)  =    11.362 [0.0034]**
```

Table 3: Estimated matrices alfa and beta, with restrictions

beta', the normalized cointegrating vectors:

	Bur_1	Ken_1	Rwa_1	Tan_1	Uga_1	Constant
CVec(1)	0	-0.163	0	-1.05	1	0.0214
		{-2.2}		{-9.4}		{2.5}
CVec(2)	0	-0.723	1	0	0	0.00391
		{-8.0}				{0.4}
CVec(3)	1	-0.375	0	0	-0.796	-0.00199
{t-value}		{-1.3}			{-2.8}	{-0.1}

alpha, the loadings on the cointegrating vectors:

	alpha[][0]	alpha[][1]	alpha[][2]
DBur	0	0	-0.146
			{-5.0}
DKen	0	0	0
DRwa	0	-0.132	0
		{-5.4}	
DTan	0.0762	0	0
	{3.7}		
DUga	-0.165	0	0
{t-value}	{-6.0}		

Pi = alpha beta', the long-run coefficients:

	Bur_1	Ken_1	Rwa_1	Tan_1	Uga_1	Constant
DBur	-0.146	0.0547	0	0	0.116	0.000291
	{-5.0}	{1.3}			{2.5}	{0.1}
DKen	0	0	0	0	0	0
DRwa	0	0.0954	-0.132	0	0	-0.000516
		{4.5}	{-5.4}			{-0.4}
DTan	0	-0.0124	0	-0.08	0.0762	0.00163
		{-1.9}		{-3.5}	{3.7}	{2.1}
DUga	0	0.0269	0	0.173	-0.165	-0.00353
{t-value}		{2.1}		{5.1}	{-6.0}	{-2.3}

ANNEX 3: VAR SPECIFICATION

The structural model is specified as follows to reflect the dynamics from period t-1 to t:

$$\beta y_t = \gamma_0 + \Gamma_1 y_{t-1} + \varepsilon_t ; \varepsilon \to i.i.d.(0, \sigma^2) \quad (2)$$

Where; $\varepsilon_t = (\varepsilon_{dt}, \varepsilon_{st})'$; ε_{dt} are demand shocks and ε_{st} are supply shocks, and they are orthogonal.

The reduced form vector autoregressive (VAR) of equation (1) can be represented as follows:

$$y_t = a_0 + A_1 y_{t-1} + u_t \quad (3)$$

Where $a_0 = B^{-1}\gamma_0 ; A_1 = B^{-1}\Gamma^{-1} ; u_t = B^{-1}\varepsilon_t$ and A_1 represents the impulse response functions of the shocks to the growth of real GDP and inflation. In order to generate the impulse response functions, we apply the Wold Decomposition Theorem on equation (3) and derive the structural moving average representation of y_t which becomes:

$$y_t = \mu + \theta(L)\varepsilon_t \quad (4)$$

where μ is a vector of constants and L is a lag operator. Equation (4) is an infinite series.
In matrix form equation (4) can be expanded as follows:

$$\begin{bmatrix} \Delta y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \theta^{(0)}{}_{11} & \theta^{(0)}{}_{12} \\ \theta^{(0)}{}_{21} & \theta^{(0)}{}_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} + \ldots \quad (5)$$

Hence the impulse response functions are derived as:

$$\theta_{11}{}^{(s)} = \left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{dt}}\right]; \theta_{12}{}^{(s)} = \left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{st}}\right]; \theta_{21}{}^{(s)} = \left[\frac{\partial y_{2t+s}}{\partial \varepsilon_{dt}}\right]; \theta_{22}{}^{(s)} = \left[\frac{\partial y_{2t+s}}{\partial \varepsilon_{st}}\right] \quad (6)$$

Considering that demand shocks do not affect the level of output in the long-run, while both shocks may affect the price level, this implies that the cumulative effect of demand shocks on real GDP is zero. That is

$$\theta_{11}(1) = \sum_{s=0}^{\infty} \theta^{(s)}{}_{11} = 0$$

Thus, the long-run impact matrix which is used to identify the B matrix in a structural VAR is as follows:

$$\theta(1) = \begin{bmatrix} 0 & \theta_{12}(1) \\ \theta_{21}(1) & \theta_{22}(1) \end{bmatrix} \quad (7)$$

Combining equations (4) and (7), we express output and inflation as a function of the demand and supply shocks.

$$\varepsilon_t = (y_t - \mu)\theta(1)^{-1} \quad (8)$$

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